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FINAL VOLUME
See Notice Inside

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

NOTICE

The publication of *Nuclear Science Abstracts* is planned to be discontinued after Vol. 33, No. 12, dated June 30, 1976. *Atomindex*, published by the International Atomic Energy Agency and a product of the International Nuclear Information System (INIS), will provide essentially identical literature coverage, subject scope, abstracting and indexing with that of *NSA*. For all practical purposes the two journals are identical. The Energy Research and Development Administration, formerly the Atomic Energy Commission, has supported the concept and development of INIS for several years. At this time, it is quite apparent that the decentralized scanning, abstracting and indexing on a country-by-country basis is reliable and successful. Consequently, it is no longer necessary for the United States to bear the entire burden of publishing an abstract journal covering the world's nuclear literature. ERDA will continue to provide coverage of U. S. nuclear literature to INIS.

Atomindex is available on a subscription basis in the United States from UNIPUB, P. O. Box 433, Murray Hill Station, New York, New York 10016, for $150 per year including cumulative indexes. ($110 per year without cumulative indexes.) For others, *Atomindex* is available from the International Atomic Energy Agency, Publications Section, P. O. Box 590, A-1011, Vienna, Austria, at the same price.

ERDA's new journal, *ERDA Energy Research Abstracts (ERA)*, will contain abstracts and indexes to all literature of ERDA origin as well as nonnuclear energy information generated by foreign countries with which ERDA has agreements for cooperation. *ERA* is available to government agencies on the same basis as *NSA* and on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information.

The public may obtain *ERA* from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The annual subscription rate for the 12 regular issues including an annual cumulative index is $119 for domestic subscribers, and $148.75 for foreign subscribers. Individual issues will be priced at $7.40 domestic, and $9.25 foreign. Separate annual index cumulations will cost $30.50 domestic, and $38.15 foreign.

INDEXES TO *NSA*

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SOLDAN, D.W., Shipping container for a bottle of radioactive material, 32:20442
SOLDAT, J.K., Dosimetry of the radioactive noble gases, 32:19918 (BNWL-SA-4813)
SOLOMAKHA, D.A., Measurement of the 1.15-μm wavelength of a helium--neon laser, 32:19585

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

URANIUM ORES/GEOCHEMISTRY
  Change of uranium concentration in plagioclase of various zones of microcline--albite--oligoclase pegmatites of Karelia, 32:19704
URANIUM ORES/LEACHING
  Preparation of uranium compounds (Patent), 32:19329
URANIUM ORES/MINING
  The uranium mining and its importance for the energy supply, 32:19701
URANIUM ORES/ORE PROCESSING
  Supplies for the fuel cycle for Spanish nuclear power plants, 32:19702
URANIUM OXIDES
  See also URANIUM DIOXIDE
  URANIUM OXIDES U308

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

20457 (LA-5954) 100-MHz POWER AMPLIFIER DESIGN AND CONTROL FOR A HEAVY-ION ACCELERATOR. Lunsford, J. S.; Shipley, J. P.; Sutton, J. **(Los Alamos Scientific Lab., N. Mex. (USA)).** Jul 1975. 11p. Dep. NTIS $4.00.

is indexed as:

LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)
  100-Mhz power amplifier design and control for a heavy-ion accelerator, 32:20457 (LA-5954)
  Characterization of transuranic solid wastes from a plutonium processing facility, 32:19398 (LA-5993-MS)
  Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen, 32:19495 (LA-UR-75-1032)
  Engineering concepts for laser-fusion reactor applications, 32:19493 (LA-UR-75-736)
  Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets, 32:19583 (LA-UR-75-1099)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

L-	**(Misc.)**	
9389	**32:20494**	**See N-74-35219**
LA-		
2429	**32:20210**	**Dep. NTIS, $12.00**
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3633	**32:21097**	**Dep. NTIS, $13.50**
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AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

22697 (AECL-5302) CHEMISTRY AND MATERIALS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1975. 127p. Dep. NTIS (US Sales Only) $6.00.

Progress is reported in several areas of solid state research including ion penetration, electron microscopy, nuclear methods of analysis, and nuclear chemistry. General chemistry research is reported on analytical chemistry, hydrogen–water exchange, radioactivity measurements, deuterium analysis, electrochemistry, mass spectrometry, and fuel analysis. Research progress is also reported on radiation chemistry, isotope chemistry, surface chemistry, properties of ceramics, properties of metals, and deuterium exchange in strongly basic systems. (JRD)

Analytical and Separations Chemistry

Refer also to abstract 22844.

22698 (LA-1018(Vol.8)) CHEMISTRY OF URANIUM AND PLUTONIUM. Volume 8. Kennedy, J. (ed.). (Los Alamos Scientific Lab., N. Mex. (USA)). 27 Jun 1947. 319p. Dep. NTIS $9.75.

Declassified 24 Jan 1973.

Chapter 8 contains analytical methods for U, Pu, and associated materials. Chapter 9 deals with control measures for radioactive hazards. (DLC)

22699 (RDT-F-3-40T(Rev.)(1-76)) METHODS FOR THE ANALYSIS OF SODIUM AND COVER GAS. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Development and Demonstration). Jan 1976. 306p. RSO.

This standard provides the sampling and analytical procedures that are to be used in implementing operating and purchase purity specifications for sodium and cover gas. It provides procedures for the following: (1) analysis of sodium and cover gas from reactor primary, secondary, and auxiliary loop systems and from large and small test and experimental systems; (2) analysis of purchased sodium; (3) analysis of purchased cover gas; (4) treatment of data; and (5) packaging of samples for shipment or storage. (auth)

22700 APPLICATIONS OF THE METHOD OF ELEMENT ANALYSIS BY PROTON-EXCITED X-RADIATION. Strashinskii, A. G.; Khomyakov, G. K.; Skakun, N. A.; Serykh, N. V.; Klyucharev, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1666-1610(Oct 1975). (In Russian).

A possibility was studied of using some thin films as substrates in the element analysis of substances by characteristic x-radiation excited with 2.5 MeV protons. The results of the analysis of aluminum and carbon films, their thickness being not more than 0.1 μm as well as of glue films are given. It is shown that in some cases thick matrices of light elements may be substrates. The analysis of several samples of water for light elements content in them (Z = 16 to 20) is performed. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 23284, 23322–23328, 23330, 23332–23334, 23409, and 23839.

22701 (CONF-741040-P2, pp 182-191) ANALYSIS OF METALLIC WEAR PRODUCTS BY FAST NEUTRON ACTIVATION. Kamykowski, E. A.; Schneid, E. J.; Kuehne, F. J.; D'Agostino, M. D. (Grumman Aerospace Corp., Bethpage, NY). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

The analysis of metallic wear products in the hydraulic and lubricating fluids of aircraft is considered useful in providing early indications of impending mechanical failure. Emission spectroscopy methods have established correlations between wear products and failure, but are incapable of detecting relatively large metal particles present in a residue which may precede the onset of rapid "catastrophic" mechanical breakdown. Fast neutron activation analysis can serve as a complementary method for the detection and assessment of total metallic residues. Initial applications of activation analysis employed NaI(Tl) detectors and multichannel analyzers (MCA) for data acquisition and relied upon the use of a least squares decay scheme technique for analysis of complex peaks. The limitation to a few pertinent elements and the establishment of a fixed counting procedure reduced the generally complex least squares method to a series of addition and multiplication operations. However, the time needed for sample analysis (approximately 2 hours), derived from the necessary time scales involved in the decay scheme method, proved too long for practical use.

22702 (CONF-741040-P2, pp 192-198) CHARACTERIZATION OF SILICON NITRIDE USING 14 MeV NEUTRONS. Burns, F. C.; Priest, H. F.; Priest, G. L. (Army Materials and Mechanics Research Center, Watertown, MA). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

There is special interest in the ceramic Si_3N_4 because it is a light weight material having high temperature oxidation and corrosion resistance, ability to withstand thermal shock, and strength at both high and low temperatures. Such a material is needed for application in high temperature gas turbines. Experimental techniques required to prepare the samples for analysis and the preparation of both low oxygen containing nickel and polystyrene holders for these samples and their respective standards are described. Results are given for total oxygen content in oxidation studies of both hot pressed and reaction bonded Si_3N_4 at 2200°F, characterization of amorphous silicon nitride, the oxygen content of alpha-silicon nitride, and the silicon-oxygen analysis of Si_3N_4 samples.

22703 (CONF-741040-P2, pp 199-208) ACCURATE DETERMINATION OF MAJOR OXYGEN IN INORGANIC AND ORGANIC REAGENTS AND INDUSTRIAL MATERIALS AS A CHECK OF PURITY AND STOICHIOMETRY. Volborth, A.; Miller, G. E.; Garner, C. K. (Univ. of California, Irvine). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

An accurate and operationally simplified system for fast neutron activation analysis is described. A sealed tube fast-neutron generator, dual rotator and transfer system were adapted for simultaneous transfer and counting and subsequent sample interchange. This arrangement removes bias by making corrections for radioactive decay unnecessary and also be equalizing gain

differences in the parallel counting electronics. Data are given for oxygen in the TiO_2 NBS Reference Standard 154b. The results indicate insufficient oxygen in this compound suggesting the presence of considerable (approximately 8.6 percent) Ti_2O_3. It is proposed that careful oxygen determination should be performed where appropriate on NBS standards in order to gain a more complete understanding of the stoichiometry of these compounds. Multivalent mixtures that have been exposed to heating, shock, oxidation, or reduction can also be subjected to such studies in order to further our knowledge of the stoichiometry of oxygen-containing compounds. The high confidence and accuracy of this analytical system is further demonstrated by results on total oxygen in benzoic acid, Fe_2O_3, Cr_2O_3, Ta_2O_5, and La_2O_3. These data also demonstrate the importance of accurate determination of the water content for powdered samples.

22704 (CONF-741040-P2, pp 279-288) LOW DOSE HUMAN CALCIUM ASSAY IN VIVO VIA THE ^{40}Ca(n, alpha) REACTION. Bigler, R. E. (Memorial Sloan-Kettering Cancer Center, New York); Davis, R. Jr.; Evans, J. C. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

A compact medical cyclotron has been investigated to elucidate its merit as a neutron source for both qualitative and quantitative activation analysis human studies in vivo of calcium and other elements within the human body and at reasonable radiation dose levels. Emphasis is given to those properties necessary for carrying out quantitative whole body calcium measurements using the ^{40}Ca(n, alpha)^{37}Ar reaction, which because of the low radiation dose and relatively modest equipment requirements, give this method potential for wide application in diagnostic studies of calcium metabolism.

22705 (CONF-741040-P2, pp 289-297) BODY COMPOSITION DETERMINATION BY MEASUREMENT OF TOTAL BODY ACTIVATION PRODUCTS IN EXPIRED AIR. Palmer, H. E. (Battelle Pacific Northwest Labs., Richland, WA); Lewellen, T. K.; Chestnut, C. H. III; Nelp, W. B. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

In-vivo neutron activation followed by whole body counting has become a routine method for measuring the major elements in the body, such as total body calcium. More recently a careful analysis of radioactive components in expired air after neutron activation has shown some of these components are directly related to the body content of major elements. The gaseous activation products are produced both by direct fast neutron reactions and by secondary proton reactions. The protons are produced by hydrogen atom recoil after neutron interaction with the large quantity of hydrogen in the body. The specific longer-lived radionuclides which are easily measured in expired air are ^{37}Ar, ^{41}Ar, ^{11}C, and ^{13}N. The ^{37}Ar is expired as noble gas and is produced by the reaction ^{40}Ca(n, alpha)^{37}Ar. The accurate determination of total body calcium in animals has been demonstrated using ^{37}Ar measurements and the determination in humans appears very feasible. The ^{11}C, expired as ^{11}CO and $^{11}CO_2$, is produced by ^{14}N(p, alpha)^{11}C and it appears that total body nitrogen can be determined from the ^{11}C measurements. The usefulness of ^{41}Ar and ^{13}N in the expired air has not yet been determined. The 14 MeV neutron generator has been the most useful and adequate source of neutrons for these studies. An increase in the neutron emission rate from these generators would improve their usefulness in these types of studies. All activation products which form gases in the body after neutron irradiation are potentially useful in determining the body content of the parent element. Several radioactive gases have been recently identified in the expired air of animals or humans after low level neutron irradiation. These include ^{37}Ar, ^{41}Ar, ^{11}Co, $^{11}CO_2$, $^{13}N_2$, ^{13}NO or $^{13}N_2O$. Other radioactive gases which can probably be measured at very low levels are $^{11}CH_3$.

22706 (CONF-750591-(Absts.)) THIRD AUSTRALIAN SYMPOSIUM ON ANALYTICAL CHEMISTRY, MELBOURNE, AUSTRALIA, MAY 27-30, 1975. Abstracts of Papers. (Royal Australian Chemical Inst., Parkville. Analytical Chemistry Div.). 1975. 77p. Royal Australian Chemical Inst., Parkville.

Topics discussed at the meeting include nuclear techniques for the bulk analysis of iron ores, neutron activation analysis, gamma spectrometric determination of uranium, and chemical separation of transuranium elements. (AT)

22707 (KFK-2201) RAPID METHOD FOR THE DETERMINATION OF MERCURY TRACES BY NEUTRON ACTIVATION ANALYSIS AND MERCURY CONTENT OF BIOLOGICAL MATERIALS OF DIFFERENT GEOGRAPHIC AND TIME ORIGINS. Rohde, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Aug 1975. 83p. Dep. NTIS (US Sales Only) $5.00.

A rapid method based on activation analysis was developed for the determination of mercury in biological material. The method employs the delayed γ rays as prompt γ rays have been shown to display insufficient sensitivity. The mercury content of 182 fish derived from the waters of the region of southwestern Germany was determined. Relatively high concentrations (>1 ppM) were measured in the muscle of Rhine fish. Similar mercury contents were observed in aged biological material (bird feathers and human hair) and contemporary living organisms. (auth)

22708 SOME TENDENCIES OF THE RADIOANALYTICAL LITERATURE. Statistical Games for Trend Evaluation. I. Distribution of the Information Sources. Braun, T. (Eotvos Univ., Budapest); Bujdoso, E. Radiochem. Radioanal. Lett.; 23: No. 4, 195-203(29 Nov 1975).

The distribution of the radioanalytical information sources was statistically evaluated by citation counting. Using some reviews and progress reports as object of this study, it seems that in the period 1956-1973 one witnesses a significant concentration of the radioanalytical information sources. (auth)

22709 EVALUATION OF THE ERROR DUE TO FLUX INHOMOGENEITY IN EPITHERMAL NEUTRON ACTIVATION ANALYSIS. Jaffrezic, H.; Joron, J. L. (CEN de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 23: No. 4, 237-242(29 Nov 1975). (In French).

Epithermal neutron activation analysis can usefully be used for the simultaneous determination of trace elements in rocks. No chemical separation is required in this case and consequently the precision may be better. One of the greatest sources of error can be neutron flux inhomogeneity in the irradiation capsule. It is shown that flux variation is about 5% in our experimental procedure. It appears also that non-random distribution of some trace elements is an important source of error in their determination. (auth)

22710 ACTIVATION ANALYSIS IN BIOLOGICAL MATERIAL. Turkstra, J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Chemistry Div.); Retief, D. H.; Cleaton-Jones, P. E. (University of the Witwatersrand, Johannesburg (South Africa). Dental Research Unit). S. Afr. Med. J.; 49: 191(8 Feb 1975).

The principles of neutron activation analysis are briefly discussed. Advantages and limitations of the technique are considered in detail, and certain applications in the biological field are illustrated. (INIS)

Chemical and Spectral Procedures

Refer also to abstracts 23329, 23560, and 23726.

22711 (AAEC/E-352) DETERMINATION OF OXYGEN IN METALS USING AN IMPULSE HEATING FURNACE EQUIPPED WITH A SAMPLE TRANSFER LOCK. Dale, L. S.; de Jong, S.; Kelly, J. W.; Whittem, R. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1975. 16p. Dep. NTIS (US Sales Only) $3.50.

An impulse heating furnace has been constructed for the determination of low levels of oxygen down to 100 μg/g in metals. The furnace is equipped with a sample transfer lock which permits samples to be loaded into outgassed crucibles in a helium atmosphere. As a result, blank levels in the range 2 to 3 μg oxygen are obtained; the modification also results in shorter sample processing time. The apparatus is described, and its suitability for oxygen determinations at these levels has been verified by comparison of results obtained on reference and analyzed materials. (auth)

22712 (CEA-R-4716) COMPARATIVE STUDY OF SOME ELECTROANALYTICAL TECHNIQUES. Application on the Determination of Trace Metallic Cations. Carrier, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. de Chimie). Jan 1976. 101p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis.

We propose in this work the comparison between two methods often used in electroanalysis; these are anodic stripping voltammetry and pulse stripping voltammetry, associated to three kinds of electrodes, hanging mercury drop electrode (EGPM), glassy carbon electrode (CV), mercury film electrode on glassy carbon (EFM). The comparison being with respect to following fundamental aspects: sensitivity, reproducibility and selectivity. It shows the particular importance of the mercury film electrode during determination of metallic cations at low concentrations

(about 10^{-8}M), or during simultaneous determination of elements like lead and thallium for which difference between half-wave potentials in polarography is very small. The end of this study gives in a very practical way the determination of some heavy metals at low concentrations in different electrolytes. (auth)

22713 (CONF-740701-, pp 69-80) ACCURACY AND PRECISION IN ACTIVATION ANALYSIS: COUNTING. Becker, D. A. (National Bureau of Standards, Washington, DC). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Accuracy and precision in activation analysis was investigated with regard to counting of induced radioactivity. The various parameters discussed include configuration, positioning, density, homogeneity, intensity, radioisotopic purity, peak integration, and nuclear constants. Experimental results are presented for many of these parameters. The results obtained indicate that counting errors often contribute significantly to the inaccuracy and imprecision of analyses. The magnitude of these errors range from less than 1 percent to 10 percent or more in many cases. (auth)

22714 (HEDL-MT-2) QUALITY ASSURANCE MANUAL FOR ANALYTICAL CHEMISTRY LABORATORY. Delvin, W. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 40p. AT.

A quality assurance plan for use by an analytical chemistry laboratory is presented as a quality assurance manual, which represents the basic quality assurance program used by the analytical laboratories at the Hanford Engineering Development Laboratory (HEDL). That program has been developed and used at HEDL during the past several years. (auth)

22715 (IS-3558(Vol.2)) BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR 1972 COMPILED BY A COMPUTER METHOD. Volume II. Key Word Out of Context (KWOC) Index. Capellen, J.; Svec, H. J.; Sage, C. R.; Sun, R. (comps.). (Ames Lab., Iowa (USA)). Aug 1975. Contract W-7405-eng-82. 520p. Dep. NTIS $13.75.

This report covers the year 1972, and lists approximately 10,000 articles of interest to mass spectroscopists. This two-volume report consists of three sections. Vol. II contains the Key Word Out of Context Index (KWOC Index) section. The KWOC Index lists the key words, the reference numbers of the articles in which the key word appears, and the first 100 characters of the title. (auth)

22716 (NIM-1723) DETERMINATION OF ZIRCONIUM AND ALUMINUM IN ZIRCONIUM–ALUMINUM ALLOYS. Laboratory Method No. 40/7. Shelton, B. J.; Cook, E. B. T. (National Inst. for Metallurgy, Johannesburg (South Africa)). 7 Nov 1975. 7p. Dep. NTIS (US Sales Only) $3.50.

A method for the rapid determination of zirconium and aluminum in zirconium–aluminum alloys is described. After dissolution of the alloy in sulfuric acid to which ammonium sulfate has been added, zirconium is determined spectrophotometrically with Arsenazo III by a published procedure. Aluminum is determined on the same solution by atomic-absorption spectrophotometry after a preliminary extraction of zirconium into a chloroform solution of di-(2-ethylhexyl)phosphoric acid. (auth)

22717 (PB-240764) SIMPLIFIED ATOMIC ABSORPTION DETERMINATION OF STABLE STRONTIUM IN MILK AND HAY: A COMPARISON OF METHODS AND STEPWISE PROCEDURE. Final Report. Barth, J.; Bruckner, B. H. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. 33p. (EPA-680/4-73-002). NTIS $3.75.

A highly simplified atomic absorption procedure for the determination of stable strontium in fluid milk, milk powder, and alfalfa is evaluated. A comparison is made between the atomic absorption method of additions and the standard curve method. A suggested stepwise procedure is given. (GRA)

22718 ANALYSIS OF ZIRCONIA AND ALUMINA PRODUCTS AND RAW MATERIALS BY X-RAY FLUORESCENCE SPECTROMETRY. Boix, A.; Draignaud, M.; Debras-Guedon, J. (Societe Francaise de Ceramique, 75–Paris). Bull. Soc. Fr. Ceram.; No. 106, 69-72(Jan 1975. (In French)

An x-ray fluorescence spectrometric method of analysis for various raw materials and materials based on zirconia, alumina and silica was developed. The measurements were made on beads made from the sample and a borax based flux, in the proportions 1:10. A repeatability test allowed the relative standard deviation to be estimated for the three main constituents: SiO_2, Al_2O_3, ZrO_2: it is at the level of 1%. The element analyzed are: Si, Al, Fe, Ti, Ca, Hf and Zr. (FR)

22719 HIGH TEMPERATURE KNUDSEN CELL MASS SPECTROMETRY. Atomization Energies Determination of Si_2, Si_3, Al_2, AlSi and $AlSi_2$. Chatillon, C.; Allibert, M. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, 38–Grenoble (France). Lab. de Thermodynamique et Physico-Chimie Metallurgiques); Pattoret, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). C. R. Hebd. Seances Acad. Sci., Ser. C; 280: No. 25, 1505-1508(30 Jun 1975). (In French)

Equilibrium gaseous species with Al-Si alloys are studied by Knudsen-cell mass spectrometry in the temperature range 1,585-1,840°K. The $AlSi_2$ molecule is identified. Atomization energies of gaseous molecules are determined. (FR)

22720 SURVEY OF URANIUM ASSAY TECHNIQUES AND MEASUREMENT CONTROL AT THE NEW BRUNSWICK LABORATORY. Pietri, C. E.; Scarborough, J. M.; Bingham, C. D. (New Brunswick Laboratory, NJ). Nucl. Mater. Manage.; 4: No. 3, 299-308(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A survey of the uranium assay techniques and a brief description of measurement control at the New Brunswick Laboratory (NBL) are provided. Types of materials analyzed are listed and typical sample handling techniques are described which are used to convert samples to solution forms which are amenable to analysis by the NBL Titrimetric Method. The program in use at NBL to assure adequate reliability of uranium measurements based on titrimetry is described. (auth)

22721 METHOD OF ANALYZING X-RAY FLUORESCENCE SPECTRA OF URANIUM SCRAP FOR SNM CONTROL MEASUREMENT PURPOSES. Harkness, A. L.; Brandenburg, R. W. (Argonne National Lab., IL). Nucl. Mater. Manage.; 4: No. 3, 368-375(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A linear regression method is described for resolving the x-ray fluorescence spectra of the scrap (i.e., dross), produced during a uranium alloying process, into the spectra of its components. This dross contains mainly uranium and zirconium and is very difficult to analyze using normal chemical procedures. A plot of the calculated spectra ratios versus the actual weight ratios for several prepared standards provides a calibration curve for obtaining quantitative analyses for uranium accountability purposes. (auth)

22722 ACIDO COMPLEX SALTS IN THE CHEMISTRY OF ACTINIDES. Nikol'skii, B. P.; Posvol'skii, M. V.; Markov, G. S. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 699-703(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 711-715(1974).

The complex anions formed by tetravalent actinides Th, Np, Pu, and U in solutions containing strong acid anions may be precipitated by quaternary ammonium bases. A systematic study of the properties of these salts showed that this precipitation method can be used for preparation of the actinides. The salts usually dissolve readily in water; the factors affecting their solubility are analyzed. The salts formed by the lanthanides under the same conditions with N-benzylquinolinium were studied and the results showed that the rare earths are not identical to the actinides in their chemistry. The method is recommended as a gravimetric method for the determination of Th, Np, Pu, and Ce. (JSR)

22723 ATOMIC ABSORPTION DETERMINATION OF PLATINUM METALS IN NON-AQUEOUS MEDIA. Communication 1. Determination of Platinum Metals After Their Extraction by Tetraoctylammoniumbromide (TOAB). Lanbina, T. V.; Yudelevich, I. G.; Vasil'eva, A. A.; Gindin, L. M. (AN SSSR, Novosibirsk. Inst. Neorganicheskoj Khimii). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 7, 78-83(May 1974). (In Russian)

For English translation see the journal Sib. Chem. J.

An atomic-absorption method was developed for determining Pt, Pd, Ir, and Ru in samples of complex composition after extraction by TOAB. The platinum metals were determined in the organic extract. The limits of detection of Pt, Pd, and Ru in an air-C_2H_2 flame and of Ir in an N_2O-C_2H_2 flame were 0.16, 0.03, 0.32, and 3.50 μg/ml. The effect of a number of elements on the determination of Pt, Ir, and Ru was studied. (INIS)

22724 ATOMIC ABSORPTION DETERMINATION OF PLATINUM METALS IN NON-AQUEOUS MEDIA. Communication 2. Determination of Platinum Metals in Samples of Complex Composition with Their Extraction by Paraoctylaniline. Lanbina, T. V.; Yudelevich, I. G.; Vasil'eva, A. A.; Gindin, L. M.; Alma-

nova, T. P. (AN SSSR, Novosibirsk. Inst. Neorganicheskoj Khimii). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 7, 83-87(May 1974). (In Russian)

For English translation see the journal Sib. Chem. J.

An atomic-absorption method for determining Pt, Pd, Rh, Ir, and Ru in samples of complex composition using p-octylaniline (OA) extraction is described. The limit of detection in the OA extract for Pt, Pd, and Ru is 2 to 4-fold lower than in aqueous solutions. For a lower limit of detection of Ir and Ru in a given extractant an N_2O-C_2H_2 flame must be used. The effect of the presence of several impurities on the determination of Pt, Ru, Rh, and Ir in the OA phase was studied. (INIS)

22725 DETERMINATION OF TRACE AMOUNTS OF MERCURY AND CADMIUM IN FOOD. Pfannhauser, W. (Lebensmittelversuchsanstalt, Vienna (Austria). Forschungsinstitut der Ernaehrungswirtschaft). Oesterr. Chem.-Z.; 76: No. 1, 1-4(Jan 1975). (In German)

Current methods and new developments in the determination of trace amounts of mercury and cadmium in food are reviewed, as well as the results of some recent series determinations of these metals. The techniques of atomic absorption spectroscopy and atomic fluorescence spectroscopy, especially in their application for the determination of mercury and cadmium, are described along with possible error sources. The results of series determinations show that tuna, but also mushrooms contain much larger amounts of mercury than other foodstuffs. Cadmium is mainly ingested with basic foodstuffs like potatoes and rice, and to a large extent also by the smoking of cigarets. (INIS)

22726 MASS SPECTRA OF ^{13}C-LABELLED COMPOUNDS. 5. Tetralin-1-^{13}C and Tetralin-2-^{13}C. Gorfinkel, M. I.; Bugreeva, N. S.; Isaev, I. S. (AN SSSR, Novosibirsk. Inst. Organicheskoj Khimii). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 7, 88-90(May 1974). (In Russian)

For English translation see the journal Sib. Chem. J.

Values found for retention of the label by $C_9H_8^+$ ions in mass spectra of tetralin-1-^{13}C and tetralin-2-^{13}C (69 and 34%, respectively) did not agree with schemes for formation of these ions proposed earlier by a number of authors. Values for retention of the label by $C_7H_7^+$ ions in mass spectra of these compounds were 52 and 13%, respectively. Results of studies indicate a complex nature of the processes of degradation of the organic molecules upon electron impact. (tr-auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 22791, 22792, 23280, 23352, and 23585.

22727 (CONF-741040-P2, pp 136-145) SOLID STATE SURFACE ANALYSIS BY ION BACKSCATTERING AND CHANNELING. Picraux, S. T. (Sandia Labs., Albuquerque, NM). 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators, Vol. II. (North Texas State Univ., Denton (USA)).

Ion backscattering provides a means to determine the atomic composition vs. depth in the near-surface region of a solid without layer removal. The backscattering technique is particularly valuable for the study of thin films and multilayer structures. Examples of applications to anodization studies and to resistor films for microelectronics circuits are given. Depth profiling is demonstrated for applications to dopant diffusion and to metal contact reactions with semiconductors. By combining ion channeling with backscattering measurements, crystallographic information such as the degree of crystal disorder and the lattice location of impurities can be obtained. Examples are given of studies of heteroepitaxial layer quality and of implanted impurity atom location.

22728 (EUR-5407i) USE OF A SINGLE TECHNIQUE FOR THE SEPARATION AND DETERMINATION OF ACTINIDES IN BIOLOGICAL MATERIALS. Camera, V.; Giubileo, M. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1975. 40p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

For the radiotoxicological survey of workers exposed to different types of alpha-emitting contaminants, a procedure was developed which permits the estimate of Th, Pa, U, Np, Pu, Am, and Cm in biological samples with a single technique. The radionuclides are extracted on a column by tri-n-octylphosphine oxide and separated by elution at different pH values. Afterwards, the quantitative determinations are done by physical methods α counting or spectrometry). In the case of an accident it is possible to use a simplification of the procedure (extraction in a beaker) for checks. A procedure for the rapid determination of actinides in feces and in nasal secretions is described. (auth)

22729 (JUL-1239) SEARCH FOR ELEMENT 114 IN NATURE. McMinn, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Sep 1975. 152p. (In German). Dep. NTIS (US Sales Only) $6.75.

Thesis. Submitted to Univ., Cologne.

The search for element 114 was based on a series of enrichments with the goal of improving upon the previous detection limit by several orders of magnitude. The samples were taken from a lead ore about 1.3×10^9 years old, and they were selectively enriched through vaporization during processing coprecipitation and countercurrent electrophoresis, resulting in an estimated chemical enrichment factor of from 2 to 3×10^6. In order to detect 10^{-21} to 10^{-19} atoms of eka-lead per atom of lead, further physical enrichment was undertaken using the Juelich electromagnetic isotope separator. Positions of individual mass lines on the mass separator targets were first determined using PbSe (masses 278 and 280 to 290). The separation efficiency was determined radiometrically in simulation experiments with ^{197}Hg. The quartz-plate targets for the separation of the lead samples were subjected to a thermal neutron flux of about 10^{21} cm^{-2} in a high-flux reactor and the resulting fission tracks counted. Background due to fissionable impurities and to the use of the mass separator were studied. Possible escape of element 114 from the γ-heating was also investigated. The diffusion behavior of carrier-free ^{203}Hg implanted into quartz plates showed that the expected losses are negligible below 200°C. Counting results from the fission-track detectors gave a maximum value of 5.1×10^{-22} barns for the product of the fission cross section σ_f and the number of eka-lead atoms per lead carrier atom. In order to be able to make an estimate of the absolute concentration limits, σ_f of eka-lead for thermal neutrons were approximated using an extrapolation method. The following upper limits were placed on the concentration: $^{296}114$: 8×10^{-24} atoms per atom lead (σ_f = 70 barns); $^{297}114$: 3×10^{-22} atoms per atom lead (σ_f = 2 barns); $^{298}114$: 1×10^{-19} atoms per atom lead (σ_f = 4 mbarns). Assuming that no fundamental errors were made, the upper limit for the concentration was lowered by 3.3 to 8.4 orders of magnitude. (182 references, 22 tables, 37 fig) (DLC)

22730 (UCRL-Trans-10708) CHEMICAL IDENTIFICATION AND PRECISE MEASUREMENT OF THE TRITIUM IN A GASEOUS MEDIUM. Dupuis, M.; Dupuis, M. C.; Charrier, G.; Colomer, J.; Humbert-Droz, C.; Lutz, M. Translated from Bull. Inf. Sci. Tech. (Paris); No. 178, 27-45(Feb 1973). 44p. Dep. NTIS $4.00.

Several techniques were developed for the identification and precise measurement of tritium in a gas sample. For specific activities ranging from 10^{-6} to a few Ci/m^3, tritium in volatile form (hydrogen or light hydrocarbons) can be identified and measured by gas radiochromatography. For lower activities, down to 10^{-12} Ci/m^3, the following methods must be used: concentration (distillation, preparative gas chromatography, purification on uranium) of the sample with respect to the tritiated compounds (water, hydrogen, hydrocarbon); and, low-level measurements (liquid scintillation, ionization chamber, or proportional counter measurements). In a gaseous medium, and in particular in air, the tritium can appear in a number of different forms, such as water, hydrogen, or light hydrocarbons. According to the desired aim, it may be of interest to determine either the total tritium concentration within the specimen or the quantity of tritium in each individual compound. To arrive at these different objectives, a number of concentration and gas-purification units capable of treating up to several m^3 of air were developed, in order to separate the different tritiated species and to prepare them for radioactivity measurements which were made at the same time an object of study and of further development. The entire complex makes it possible to carry out precise measurements of the specific tritium activity in an interval ranging from 10^{-12} up to a few Ci per m^3 of gas. (auth)

22731 DETERMINATION OF PLUTONIUM IN ENVIRONMENTAL SAMPLES. I. Development of Methods. Reynolds, S. A.; Scott, T. G. (Oak Ridge National Lab., TN). Radiochem. Radioanal. Lett.; 23: No. 4, 269-274(29 Nov 1975).

A brief description is presented of development of methods for plutonium in water, soil, and biological materials. Wet ashing is preferred for organic substances, and precipitation is used instead of evaporation for large aqueous samples. Separation methods studied included anion exchange, precipitation, and extraction with TTA-xylene. (auth)

22732 DETERMINATION OF PLUTONIUM IN ENVIRONMENTAL SAMPLES. II. Procedures. Scott, T. G.; Reynolds, S. A. (Oak Ridge National Lab., TN). Radiochem. Radioanal. Lett.; 23: No. 4, 275-281(29 Nov 1975).

Detailed procedures are reported which have been applied to numerous samples. Soils are leached with nitric acid, and organic matter is destroyed with peroxide. Carrying on bismuth phosphate

or calcium oxalate is employed for concentrating plutonium. Separation is done by anion exchange, and TTA extraction is used for final isolation and preparation of plates for alpha-activity measurement. (auth)

22733 RECENT DEVELOPMENTS OF NNC MULTI-CHANNEL "FUEL SCAN." Miller, H.; Shepard, S. H. (National Nuclear Corp., Redwood City, CA). Nucl. Mater. Manage.; 4: No. 3, 567-576(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

This paper reports on the latest evolution of a very high speed fuel rod assay system. The system uses a large californium-252 source and coincidence detection. Scan speeds up to a rod a minute are possible for both off-spec pellet detection and total fissile determination. Additional capabilities, such as pellet density determination, gap measurement, and fissile column length measurement are described. The rod handling mechanism and automation of data output are also described. 6 figures. (auth)

22734 ADVANCES IN FUEL ROD CALORIMETRY WITH THE ANL FFTF CALORIMETER. Beyer, N. S.; Perry, R. B.; Lewis, R. N. (Argonne National Lab., IL). Nucl. Mater. Manage.; 4: No. 3, 577-581(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

This is a summary article describing the new ANL Model IV Fuel Rod Calorimeter which incorporates a microprocessor control-readout system to make measurements of the plutonium content of FFTF fuel rods with an uncertainty of +- 0.2 percent in a 15 minute measurement period. Full details of component design and operating response characteristics are not presented because rigorous evaluation studies have not been completed. (auth)

22735 MOBILE ASSAY LABORATORY FOR ^{235}U SAFEGUARDS MEASUREMENTS. Eldridge, J. S. (Oak Ridge National Lab., TN); Lyon, W. S.; Clay, E. L. Nucl. Mater. Manage.; 4: No. 3, 357-367(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Nondestructive gamma spectroscopic techniques for the determination of uranium enrichment or concentration are conducted in a mobile assay laboratory. The system consists of a sodium iodide gamma spectrometer and 4096-channel computer analyzer housed in an air-conditioned van-type vehicle. Calibrations and measurements have been performed with UO_2 powder and sintered pellets (low enriched) and for various types of high enriched fuels at fabrication facilities. The system has been a useful tool for on-site inventory certifications. (auth)

22736 IN-PLANT EVALUATION OF THE NDA OF HTGR FUEL. Glancy, J. E.; Snooks, E. C. (General Atomic Co., San Diego, CA). Nucl. Mater. Manage.; 4: No. 3, 92-106(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Two state-of-the-art nondestructive assay instruments, the LASL Random Driver and the LASL Segmented Gamma-Ray Scanner, are undergoing in-plant evaluation for the assay of HTGR fuel materials for the improvement of HTGR fuel accountability. Test results include measurements of the instrument operating parameters such as stability, reliability, sensitivity to operating and environmental conditions, and ease of operation. Instrument performance results are also presented and error statements are given in terms of the calibration error, the reproducibility of measurement, the error caused by variable material from, and the bias relative to results obtained using sampling and chemical analysis. (auth)

22737 NEW AUTOMATED PELLET/POWDER ASSAY SYSTEM. Olsen, R. N. (National Nuclear Corp., Redwood City, CA). Nucl. Mater. Manage.; 4: No. 3, 128-136(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

This paper discusses an automated, high precision, pellet/powder assay system. The system is an active assay system using a small isotopic neutron source and a coincidence detection system. The handling of the pellet or powder samples has been automated and a programmable calculator has been integrated into the system to provide control and data analysis. The versatile system can assay uranium or plutonium in either active or passive modes.

22738 PASSIVE AND ACTIVE MEASUREMENT OF SNM IN 55-GALLON DRUMS. Bramblett, R. L. (IRT Corp., San Diego, CA). Nucl. Mater. Manage.; 4: No. 3, 137-151(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc., New Orleans, LA, USA (18 Jun 1975).

In many government and private nuclear fuels facilities, waste containing SNM is packaged in large drums. Future facilities will generate large volumes of low SNM content waste. Economics of small container assay relative to large drum assay is addressed, and the question of contribution of drum assay to LEMUF is investigated. The measurement alternatives for ^{235}U and ^{239}Pu in large gallon drums and their accuracies are reviewed. Techniques reviewed include passive gamma-ray and neutron assay, active neutron assay, and bremsstrahlung assay. The influence of fission products on the measurements is considered. (auth)

22739 CALIBRATION AND QUALIFICATION OF THE ISOTOPIC SOURCE ADJUSTABLE FISSOMETER (ISAF) FOR ASSAY OF LOW-ENRICHED DISCREPANT URANIUM MATERIALS. Weber, H. J. (IRT Corp., San Diego, CA); Stewart, J. P. Nucl. Mater. Manage.; 4: No. 3, 167-179(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A description of the installation, intended usage, calibration, and planned qualification of an Isotopic Source Adjustable Fissometer (ISAF) for nondestructive assay of bulk quantities of low-enriched discrepant uranium materials at the General Electric Company's Nuclear Fuel Division is presented. The instrument design stresses ease of operation and maintenance. Operator skill requirements are kept at a minimum by automatic, on-line data processing capability. The calibration results show good accuracy for certain discrepant low-enriched materials. The instrument is expected to be qualified as part of a material accountability balance, thereby reducing participation of laboratory analysis. (auth)

22740 EXPERIENCE WITH A FUEL ROD ENRICHMENT SCANNER. Kubik, R. N.; Pettus, W. G. (Babcock and Wilcox, Lynchburg, VA). Nucl. Mater. Manage.; 4: No. 3, 194-201(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

This enrichment scanner views all fuel rods produced at B and W's Commercial Nuclear Fuel Plant. The scanner design is derived from the PAPAS System reported by R. A. Forster, H. D. Menlove, and their associates at Los Alamos. The spatial resolution of the system and smoothing of the data are discussed in detail. The cost-effectiveness of multi-detector versus single detector scanners of this general design is also discussed. (auth)

22741 METHOD FOR SIMULTANEOUS DETERMINATION OF THE ISOTOPES ^{230}Th, ^{232}Th, ^{231}Pa, ^{238}U, AND ^{226}Ra IN ONE SAMPLE OF SEDIMENTARY MATERIALS. Kuznetsov, Yu. V.; Legin, V. K.; Simonyak, Z. N.; Elizarova, A. N.; Pospelov, Yu. N.; Al'tarman, E. I. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 527-530(1974).

Translated from Radiokhimiya; 16: No. 4, 535-539(1974).

A method is proposed for the determination of ^{230}Th, ^{232}Th, ^{231}Pa, ^{238}U, and ^{226}Ra on one sample of sedimentary materials. The reliability of the method was checked on samples with a known content of the radioelements investigated (equilibrium pitchblende). (auth)

Separation Procedures

Refer also to abstracts 22820, 22841, and 25162.

22742 FABRICATION OF $LiD_{0.5}T_{0.5}$ MICROSPHERES FOR USE AS LASER FUSION TARGETS. Carstens, D. H. W.; Farnum, E. H.; Fries, R. J.; Sheinberg, H. (Los Alamos Scientific Lab., N. Mex. (USA)). J. Nucl. Mater.; 57: No. 1, 1-10(Jul 1975).

A method to fabricate high-quality $LiD_{0.5}T_{0.5}$ microspheres having diameters from 40 to 125 mu m was developed. These can be provided with a uniform several mu m thick coating of nickel, if desired. Techniques were also developed to mount the Li(D,T) microspheres on very thin plastic films to support them for irradiation in the laser beam and to provide them with disk-shaped absorber/ablator layers if desired. (NL)

22743 EXTRACTION OF URANIUM(VI) FROM SULFURIC ACID BY TOA IN TOLUENE. Juznic, K.; Fedina, S. (Jozef Stefan Inst., Ljubljana, Yugoslavia). Radiochem. Radioanal. Lett.; 23: No. 4, 243-248(29 Nov 1975).

The extraction of U(VI) from sulfuric acid of moderate concentration by tri-octyl amine in toluene has been studied. The results obtained for the uranium distribution, sulfate transfer and the dependence of the distribution ratio on amine and sulfuric acid concentration are examined in terms of the extraction equations and the possible adducts formed in the organic phase. (auth)

22744 IMPROVEMENTS IN AND RELATING TO ION-EXCHANGE. Heal, H. G. (to National Research Development Corp.). British Patent 1,397,724. 18 Jun 1975. Filed dat 1 Jun 1971. 3p.

It has been found that the relatively expensive ion exchange materials normally used can be extensively replaced by relatively inexpensive material comprised of long-weathered basalt. This has been found to effect rapid and efficient ion exchange with a capacity comparable with, and in some cases greater than, the usual artificial materials. The basalt should contain at least 50% by weight of particles of size below 3 cm mesh. Olivine basalt has proved particularly effective. Examples given include removal of Cu and Co, application to water softening, and to the removal of ^{137}Cs from milk. Other applications mentioned include removal of Ca, ^{90}Sr, Pb, Zn, Hg, Ni, and Cr, extraction of metal ions from seawater, purification of industrial effluents, etc. (UK)

22745 SORPTION OF HEPTAVALENT NEPTUNIUM ON SOME METAL HYDROXIDES. Zakharova, F. A.; Orlova, M. M.; Alekseeva, D. P.; Krot, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 538-539(1974).

Translated from Radiokhimiya; 16: No. 4, 546-548(1974).

The sorption of neptunium (VII) under static and dynamic conditions on hydroxides of lanthanum, thorium, zirconium, titanium, and magnesium and also on precipitates of sodium uranates. (LK)

22746 EFFECT OF TEMPERATURE ON EXTRACTION OF ALKALI AND ALKALINE EARTH ELEMENTS BY D2EHPA. Smelov, V. S.; Lanin, V. P. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 425-428(1974).

Translated from Radiokhimiya; 16: No. 4, 432-436(1974).

Data are given on the temperature dependence of the extraction constants of Na, Rb, Cs, Sr, and Ba by HDEHP. (LK)

22747 REACTION OF HIGH-MOLECULAR ORTHO-SUBSTITUTED PHENOLS WITH ALKALI METALS. Lanin, V. P.; Smelov, V. S. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 429-432(1974).

Translated from Radiokhimiya; 16: No. 4, 436-440(1974).

The use of 2-phenylphenol as an extractant for rubidium, cesium, and sodium was investigated. The interaction of cesium and rubidium with 2-phenylphenol at hydrogen ion concentrations of 1×10^{-3} to 1×10^{-2} M was studied in detail. (LK)

22748 PHYSICOCHEMICAL AND EXTRACTION PROPERTIES OF TBP–TETRACHLOROETHYLENE SYSTEMS. Zakharkin, B. S.; Nikipelov, B. V.; Saprykina, E. I.; Shevtsev, P. P. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 442-446(1974).

Translated from Radiokhimiya; 16: No. 4, 449-455(1974).

An examination was made of the physicochemical properties of tetrachloroethylene in connection with its possible use as a diluent for extractants. For the system 30% TBP–tetrachloroethylene we obtained data on the hydrodynamic characteristics (the specific gravity, viscosity, and surface tension) in relation to the uranium content of the organic phase, the rates of layer formation, and the entrainment of the phases in continuous extraction. In the system 30% TBP–tetrachloroethylene–HNO_3 we studied the extraction behavior of uranium, neptunium (VI) and (IV), and plutonium (IV). The experimental data were formalized in a form which was suitable for use in calculating the distribution of the elements on a computer. The results of the work show that it is possible in principle to use tetrachloroethylene–a nonflammable substance–as a diluent for TBP in extraction processes. (auth)

22749 SOME RULES OF THE EXTRACTION OF ACTINIDE ELEMENTS. Rozen, A. M.; Nikolotova, Z. I.; Kartasheva, N. A.; Mamaev, L. A.; Martynov, B. V.; Denisov, D. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 675-682(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 686-695(1974).

Studies by others on the effect of the structure of organic compounds on the extraction of actinide elements were generalized to derive correlation equations for the prediction of the extractability. Statistical thermodynamics satisfactorily explains the relations found. (JSR)

22750 SEMICOUNTER-CURRENT EXTRACTION METHODS OF SEPARATING TRANSPLUTONIUM ELEMENTS IN THE TRIVALENT STATE. Korpusov, G. V.; Kuznetsov, G. I.; Patrusheva, E. N.; Popkov, G. P.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 683-688(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 695-701(1974).

Semicounter-current extraction methods were evaluated for the separation of transplutonium elements. The principles of the method and the extraction equipment are described. Experimental studies were made on Cm, Bk, and Cf using the extraction system 2-ethylhexylphenylphosphonic acid in diethylbenzene–HNO_3. The results showed that separation of these elements with high efficiency was possible with the semicounter-current method. The efficiency of the operation was verified on the separation of a mixture of Cm and Eu. (JSR)

22751 EXTRACTION OF TRANSPLUTONIUM ELEMENTS BY MIXTURES OF REAGENTS. Chmutova, M. K.; Myasoedov, B. F.; Kochetkova, N. E.; Spivakov, B. Ya.; Zolotov, Yu. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 689-692(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 702-705(1974).

The synergistic effect gained by mixing a chelate-forming reagent with donor-active additives was studied for Am, Cm, and Cf. The study showed that the synergistic effect is strongest when the solvent is the least polar. The addition of a neutral donor-active additive increased the synergistic effect. The synergistic effect was such that the transplutonium elements could be extracted quantitatively from acid medium. Possible mechanisms responsible for the synergistic effect were discussed and eliminated except for the direct solvation of the metal. (JSR)

22752 EXTRACTION OF TRANSPLUTONIUM ELEMENTS BY SOME ORGANOPHOSPHORUS ACIDS. Vereshchagin, Yu. I.; Shvetsov, I. K. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 693-698(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 705-711(1974).

Values were obtained for the distribution coefficients of Cm, Bk, and Cf from 0.1 to 0.6 M HNO_3 solution for extractants of phosphoric acid esters. The apparent extraction constants of Cm, Bk, and Cf were calculated and the effective constants ($\overline{K}$) were determined by graphical extrapolation $\overline{K} \rightarrow J \rightleftharpoons 0$. The values of $\gamma_{\pm TPE(NO_3)_3}$ for microconcentrations of Cm, Bk, and Cf in nitric acid solutions were estimated. It was shown that the extraction of Cm, Bk, and Cf by dialkylphosphoric acids, whose substituents have the same electronegativities, but differ in length (steric effect), is described by the relation $\log K = \text{const} + q\Sigma l$. An increase in the steric effects in the extractants produces hardly any increase in their selectivity. (auth)

22753 GAS CHROMATOGRAPHY AND THERMOCHROMATOGRAPHY IN THE STUDY OF TRANSURANIUM ELEMENTS. Zvara, I.; Aikhler, V.; Belov, V. Z.; Zvarova, T. S.; Korotkin, Yu. S.; Shalaevskii, M. R.; Shchegolev, V. A.; Yussonnua, M. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 709-715(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 720-727(1974).

The results of studies made at the Joint Institute for Nuclear Research on the separation of the actinide, transactinide, and far transuranium elements using gas chromatography and thermochromatography are summarized. The studies made on the far transuranium elements were simulated studied using the comparatively volatile elements Cd, In, Sn, Te, Sb, I, and similar elements to determine the conditions and separation characteristics. The results of the separation of the actinide elements showed that Pu, Am, and Cm can be separated in the form of complexes of their chlorides with $AlCl_3$. Much of the work on the transactinide elements centered on the separation and behavior of element 105. Properties of volatile inorganic compounds of W and Re were also studied to select the conditions for the chemical identification of elements 106 and 107. (JSR)

22754 USE OF HIGHER VALENCE STATES IN THE ISOLATION AND DETERMINATION OF AMERICIUM AND BERKELIUM. Myasoedov, B. F. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 716-721(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 728-733(1974).

The results of the investigation of the radiolytic reduction of penta- and hexavalent Am, various methods of oxidizing Bk to the tetravalent state, and the development of new methods of isolating and determining these elements are summarized. Am and Bk could be separated from perchlorate solution by a mixture of benzoylpyrazolone and TOPO in cyclohexane. The Am could then be determined spectrophotometrically by Arsenazo III. Bk can be quantitatively desorbed from zirconium phosphate–silicate sorbent by the use of 7 M HNO_3. (JSR)

22755 SOME METHODS OF ISOLATING TRANSPLUTONIUM ELEMENTS. Kosyakov, V. N.; Chudinov, E. G.; Shvetsov, I. K. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 722-728(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 734-741(1974).

The results of an investigation of the behavior of transplutonium elements in extraction systems with D2EHPA and tertiary amines are reported. These results made it possible to develope some methods for isolating and purifying these elements and to propose an original scheme for the chemical processing of irradiated targets. An extraction chromatographic variant of the "Talspik" process. The method for the extraction and separation of Bk is based on the extraction of the metal in the tetravalent state with D2EHPA with subsequent re-extraction with a solution of DTPA in lactic acid containing hydroxylamine. Tertiary alkylamine nitrates were used for the separation of trivalent transplutonium elements. A step-by-step scheme for the processing of irradiated target and the extraction separation of Pu, Bk, Cm, Cf, and Es was outlined. (JSR)

22756 EXTRACTION OF SOME ACTINIDES BY METHYLTRIOCTYLAMMONIUM (MTOA) CARBONATE. Alekseeva, N. A.; Bulyanitsa, L. S.; Koval'skya, M. P. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 566-570(1974).

Translated from Radiokhimiya, 16: No. 5, 575-580(1974).

The process and mechanisms of the extraction of ^{233}U, ^{241}Am, and ^{239}Pu by MTOA were studied and compared with previous results. The relation of the distribution coefficients of the actinides to the MTOA concentration in the organic phase was determined for different compositions of the aqueous phase. The extraction mechanism and the distribution scheme in the organic and aqueous phases are discussed. (JSR)

22757 EFFECT OF NATURE OF ANIONS ON EXTRACTION OF URANIUM (VI) SALTS INCLUDING THESE ANIONS. Schmidt, V. S.; Rybakov, K. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 571-574(1974).

Translated from Radiokhimiya, 16: No. 5, 580-584(1974).

On the example of the extraction of uranium (VI) from solutions of various acids by tri-n-octylammonium it was confirmed that the nucleophilicity parameters of the anions of these acids H may be used to predict the effect of the nature of the latter on the extraction of like salts of metals. It was shown that the extraction constants of uranium (VI) increase with an increase in the nucleophilicity parameters H of the main anion-ligands of the system and the form of the relation of the distribution coefficient to the acidity changes correspondingly from type A to B and then to C. It was shown that for systems with acetate, formate, lactate, monochloroacetate, dichloroacetate, trichloroacetate, trifluoroacetate, and nitrate ions a linear relation is observed between the logarithms of the extraction constants of uranium (VI) by salts of tri-n-octylammonium to the nucleophilicity parameters of these anions. (auth)

22758 COORDINATION CHEMISTRY OF RUTHENIUM IN EXTRACTION PROCESSES WITH ORGANOPHOSPHORUS COMPOUNDS. V. Extraction of Pentahalo Complexes of Nitrosoruthenium by Solutions of Salts of Quaternary Phosphonium Bases. Sinitsyn, N. N.; Travkin, V. F.; Shepelev, A. D. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 575-578(1974).

Translated from Radiokhimiya, 16: No. 5, 584-588(1974).

A study was made of the extraction of pentahalo complexes of nitrosoruthenium $[RuNOX_5]^{2-}$ from hydrochloric acid solutions by the quaternary phosphonium bases R_4PBr. It was shown that the extraction of nitrosoruthenium falls with an increase in the acidity of the aqueous phase and increases with a change from chloro to bromo and then iodo ligands in the inner sphere of the complexes. On the basis of the investigations carried out an equation was derived to describe the extraction. The complex compound $(R_4P)_2[RuNOCl_5]$ formed in the extraction was isolated in a pure state and studied by various physicochemical methods. (auth)

22759 ION EXCHANGE PROPERTIES OF ZEOLITE NaY RELATIVE TO RADIOACTIVE RARE EARTH ELEMENTS. Brezhneva, N. E.; Kapshaninov, Yu. I.; Popov, I. B.; Ivanov, V. V. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 587-590(1974).

Translated from Radiokhimiya; 16: No. 5, 596-601(1974).

An investigation was made of the ion exchange properties of the zeolite NaY with respect to rare earth cations under static conditions. The ion exchange capacity of the zeolite NaY with respect to rare earth ions was found to equal 2.66 mg-equiv/g. The composition of the elementary cell of the zeolite used was established. The laws of ion exchange of rare earth elements on the zeolite NaY were investigated. (auth)

22760 EFFECT OF THE STRUCTURE ON THE EXTRACTION POWER OF SULFOXIDES. II. Extraction of Uranyl Nitrate. Fedoezzhina, R. P.; Buchikhin, E. P.; Zarubin, A. I.; Kanevskii, E. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 626-629(1974).

Translated from Radiokhimiya; 16: No. 5, 638-641(1974).

The extractive capacity of diheptyl, decylbenzyl, and diphenyl sulfoxides in benzene, chloroform, and CCl_4 were studied in order to obtain quantitative data characterizing the extraction power of sulfoxides with different induction characteristics of the S atom toward uranyl nitrate. Extraction isotherms, the equilibrium distributions, and extraction constants were determined for the various solvents. The data show that the extraction power of sulfoxides increases with a decrease in the sum of the induction constants of the substituents at the S atom. (JSR)

22761 EXTRACTION OF MICROAMOUNTS OF PLUTONIUM FROM FLUORIDES BY ALUMINUM. Kashcheev, I. N.; Novoselov, G. P.; Zolotarev, A. B. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 630-631(1974).

Translated from Radiokhimiya; 16: No. 5, 641-643(1974).

An investigation was made of the extraction of microamounts of plutonium from fluoride by aluminum. It was shown that at 1000° the extraction of plutonium by aluminum from sodium fluoride is 84 to 97% in 30 min and from lithium fluoride it is 99.7% in 180 min. Reasons are put forward for the difference in the processes in systems with NaF and LiF. (auth)

22762 SURFACE REACTIONS IN SOME EXTRACTION SYSTEMS. Kletenik, Yu. B.; Vinokurova, O. B. (AN SSSR, Novosibirsk. Inst. Fiziko-Khimicheskikh Osnov Pererabotki Mineral'nogo Syr'ya). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 7, 22-29(May 1974). (In Russian)

For English translation see the journal Sib. Chem. J.

The kinetics of extraction of Be, In, and Fe from strong acid media by benzene solutions of dibutylphosphoric acid (DBPA) was studied. The constancy of the values of the heterogeneous constants of mass transfer with change in the specific interphase surface area in three series of experiments indicated a limiting role of the surface reactions in these systems. The stoichiometry of the reactions was determined. The activation energy of the processes studied was 5 to 12 kcal/mole. The extraction was carried out under conditions that prevented localization of the reactions in the diffusion layer. The concentration profiles of the two main reactions, reactions in the diffusion layer around the interphase surface and reactions in the adsorbed layer at the interphase surface, were compared. The expediency of introducing an index to reflect the state of the sorption of reagent particles on the interphase surface was demonstrated. (tr-auth)

22763 EXPERIMENTAL EVIDENCE OF LASER-INDUCED SEPARATIONS IN BULK GAS MIXTURES. Rinehart, E.A.; Richardson, J.H.; Johnson, D.C.; Hrubesh, L.W. (University of California, Lawrence Livermore Laboratory, P. O. Box 808, Livermore, California 94550). Appl. Phys. Lett. 28: No. 3, 131-132 (1 Feb 1976).

Radiation from a cw CO_2 laser is used to separate SF_6 molecules from helium molecules in a bulk mixture of each, by resonant radiation pressure. These experimental results demonstrate that selective absorption of radiation can cause physical separations of molecules within a diffusion-limited geometry. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 23007.

Chemical and Physicochemical Properties

Refer also to abstracts 22759, 23665, 23738, 23823, and 24312.

22764 (AECL-5251) THERMODYNAMIC PROPERTIES OF DISSOCIATING N_2O_4 AT LOW TEMPERATURES AND PRESSURES. Bowman, W.; Bradley, W. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1975. 33p. Dep. NTIS (US Sales Only) $4.00.

The thermodynamic properties of dissociating N_2O_4 for the region of 0.01 to 1 atm pressure and 262K to 300K have been computed based on the method of Nesterenko and Bubnov. The methods and assumptions used for the calculations are described. T-S, H-S and P-H diagrams are included for the entire temperature and pressure range of interest for thermal power stations to take advantage of the low winter heat sink in Canada. (auth)

22765 DETERMINATIONS OF INTRINSIC VISCOSITIES AND AVERAGE MOLECULAR WEIGHT OF HIGH BOILER-RESIDUE OF TRR IRRADIATED HB-40 COOLANT. Chen, J. W.; Chu, T. J. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 3, 151-162(Sep 1975).

This investigation has been carried out with a view of studying the intrinsic viscosity effect and the relationship of it on the molecular weight relevant to the polymerized components of irradiated polyphenyl mixtures (e.g. HB-40) and further of developing a possible method for checking the state of the organic coolants in the Taiwan Research Reactor (TRR). (auth)

Isotope Effects

Refer also to abstract 23680.

22766 ISOTOPE EFFECT ON PHYSICAL ADSORPTION ON A NONHOMOGENEOUS SURFACE. Maiseyev, N. (Israel Atomic Energy Commission, Beersheba). J. Chem. Soc. (London), Faraday Trans., I; 71: No. 9, 1830-1837(1975).

Nonhomogeneity of adsorption sites is shown, by a model calculation, to account for a non-monotonic temperature dependence of the isotope separation factor α in adsorption of a monoatomic gas on a solid adsorbent. Such a non-monotonic dependence was experimentally observed by Purer, Kaplan and Smith [J. Chromatog. Sci. 7, 504 (1969)]. The model calculation shows that a non-monotonic temperature dependence of α arises when there are two types of adsorption site, one for which the energy of interaction with the adsorbed atom is characterized by a shallow but narrow potential well and the other for which the well is deeper and wider. It is also shown that wide holes or planar sections in the solid adsorbent and narrow holes correspond, respectively, to these two types of adsorption site which exist when the adsorbent is a porous glass. (auth)

22767 REMARKS ON THE DETERMINATION OF THE ODD-EVEN STAGGERING PARAMETER IN THE SPECTRUM OF CADMIUM. Gerstenkorn, S. (Laboratoire Aimé Cotton, C.N.R.S. II, F-91405 Orsay, France); Stroke, H.H. J. Opt. Soc. Am. 66: No. 2, 155-155 (Feb 1976).

From an analysis of the isotope shifts in the Cd 3261, 4678, and 4416 Å lines, it is pointed out that a precise determination of the odd-even staggering parameter is limited less by experimental error than by the lack of reliable knowledge of the specific mass effect. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 23430.

22768 (MLM-2236) 122. THE THERMAL DIFFUSION COLUMN. X. On the Theory of Quantitative Separation of Gas Mixtures. Schumacher, E. Translated by W. J. Roos from Helv. Chim. Acta; 36: 949-961(1953). 15p. Dep. NTIS $3.50.

The treatment of the behavior of polycomponent mixtures in the thermal diffusion column leads to discussion of a suggested way to quantitatively separate binary and polycomponent mixtures. This consists of using an auxiliary gas with specific properties. For determination of the conditions under which the method must be carried out, the properties of polycomponent isotopic mixtures in the thermal diffusion column were investigated. Expressions were derived for the steady state concentration distribution along the separation apparatus. A middle component exhibits a maximum in the concentration curve, which lies at the place where the mean mass of the gas is equal to the mass of that particular component. The distribution of a ternary isotopic mixture is discussed exactly, and the procedure for quantitative separation of binary systems is explained in this framework. Guidelines are given for isolation of the isotope ^{36}Ar, and general comments are made relative to obtaining rare middle isotopes by a continuous process. The treatment of nonisotopic mixtures is discussed briefly. (auth)

22769 (ORNL/TM-5191) ISOTOPE SEPARATIONS SECTION PROGRESS REPORT FOR QUARTER ENDING SEPTEMBER 30, 1975. Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 12p. Dep. NTIS $4.50.

Work on the separation of stable and radioactive isotopes is outlined. Included are recovery of ^{235}U, and enrichment of ^{41}Ca and ^{205}Pb. Progress is reported in research on the improvement of rare earth isotope separation. (JGB)

22770 XENON DICHLORIDE. Beattie, T. R.; German, A.; Blayden, H. E.; Brumbach, S. B. (Southampton Univ., Eng.). J. Chem. Soc. (London), Dalton Trans.; No. 16/17, 1659-1662 (1975).

The synthesis of isotopically enriched $XeCl_2$ (82% ^{136}Xe) for IR studies, the resolution of the chlorine-isotope structure of $XeCl_2$ in the Raman effect, and the photolytic synthesis of this molecule (all in a matrix host of xenon containing chlorine) have enabled the identification of ν_1 and ν_3 of $XeCl_2$ together with its characterization. Earlier work on $XeCl_2$ and related compounds is critically discussed. (auth)

22771 C-H/C-D EXCHANGE IN IMIDAZOLIUM (PILOCARPINIUM) AND IN 2- AND 4-HYDROXIMINOMETHYL PYRIDINIUM COMPOUNDS. Ben-Bassat, A. A.; Lavie, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Organic Chemistry). Isr. J. Chem.; 12: No. 4, 845-856(Aug 1974).

The H-D exchange of methylene protons in a side-chain when situated between a positively N-atom (α-CH_2) and a ketone function was studied in various pilocarpinium (N-methyl imidazolium) and hydroximinomethylpyridiniums using NMR measurements. Structural factors which determine the course of the exchange are reported, and the role of the solvent was examined. Mass-spectra of nondeuteriated and deuteriated 4-hydroximinomethyl-1-phenacyl-pyridinium chloride confirmed the fast exchange of the α-CH_2. An alternative H-D exchange of the C_2-H in the imidazolium moiety of certain pilocarpinium compounds without a ketone in the N-chain was detected. Mechanisms for the two types of exchange involving an ylid as intermediate and attack of a deuteron were proposed. (auth)

22772 PHOTOCATALYTIC PROPERTIES OF BERYLLIUM OXIDE PHOTOACTIVATED HOMOMOLECULAR OXYGEN EXCHANGE. Kuznetsov, V. N.; Lisachenko, A. A.; Vilesov, F. I. (Scientific-Research Inst. of Physics, Leningrad). Dokl. Phys. Chem. (Engl. Transl.p; 222: No. 4-6, 637-639(Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 4, 1373-1376 (Jun 1975).

The effect of uv irradiation in isotopic exchange in the molecular oxygen/beryllium oxide system was investigated. Luminophore-grade BeO with a paramagnetic impurity content of not more than 10^{-6} was used. The starting mixture contained natural oxygen and oxygen enriched with ~60% of the ^{18}O isotope in a ratio of 1:1. (LK)

Feed Materials Processing

Refer also to abstract 22841.

22773 (IEA-379) TECHNOLOGY FOR THE PREPARATION OF URANIUM TETRAFLUORIDE BY HYDROFLUORINATION OF UO_2 OBTAINED FROM AMMONIUM DIURANATE. Filho, A. C.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1975. 51p. (In Portuguese). Dep. NTIS (US Sales Only) $4.50.

The UO_2 was obtained by thermal decomposition of amonium diuranate to UO_3 and its reduction with hydrogen generated by cracking ammonia gas. The purpose is to acquire experience for UF_4 preparation and its technology and to find the best operation conditions, envisaging the installation of an experimental semipilot unit for training and small production. The experiments were carried on laboratory scale and the experimental parameters studied were UO_2 characteristics (specific area and O/U ratio) hydrofluorination temperature and time, and HF (anhydrous) excess. The best operation conditions were found relating the UO_2 characteristics and the effect of the experimental parameters with respect to the UF_4 properties, to the conversion yield of the hydrofluorination reaction. (21 tables, 15 fig, 43 references) (auth)

22774 (NIM-452) PURLEX PROCESS: A DESCRIPTION OF THE PILOT PLANT LEADING TO THE USE OF THE PROCESS IN SOUTH AFRICA. Project Report No. 9 (Final). Tunley, T. H.; Faure, A. (National Inst. for Metallurgy, Johannesburg (South Africa)). Oct 1975. 21p. Dept. NTIS (US Sales Only) $3.50.

Purlex is a process for the direct extraction of U from the low-grade liquors produced by acid leaching. It is similar to the U. S. Amex process. This report briefly describes the pilot plant and highlights the important findings of the testwork. Particular attention is paid to the problems which arose during the two-year period of operation and the steps taken to solve these problems. Average values are given for the important parameters for the various test periods. (auth)

Radiation Chemistry

Refer also to abstracts 23832 and 24945.

22775 (AD/A-009466) EXPERIMENTAL METHODS OF DETERMINING THE RADIOLYSIS PRODUCTS OF ALKALI METAL AZIDES. Abakumov, E. P.; Zakharov, Yu. A. Translated from Izv. Tomsk. Politekh. Inst.; No. 199, 56-60(1969). 8p. (FSTC-HT-23-917-73). NTIS $3.25.

Methods of determining all radiolysis products in sodium azide crystals irradiated with x-ray and photon radiations are presented. First the nitrogen evolved from the crystal was determined; next, the nitrogen trapped by the azide matrix in dissolution; and then the remaining products (OH(-) and NH3) and the undecomposed azide group. (GRA)

22776 (JAERI-M-6260) ANNUAL REPORT OF THE OSAKA LABORATORY FOR RADIATION CHEMISTRY, JAPAN ATOMIC ENERGY RESEARCH INSTITUTE (No. 8), APRIL 1, 1974-MARCH 31, 1975. (Japan Atomic Energy Research Inst., Ne-

yagawa, Osaka. Osaka Lab. for Radiation Chemistry). Oct 1975. 91p. Dep. NTIS (US Sales Only) $5.00.

Research progress in the following fields is described: studies related to reactions of carbon monoxide and hydrogen; polymerization studies under the irradiation of high dose rate electron beams; modification of polymers; fundamental studies on polymerization, degradation, crosslinking, and grafting. (auth)

22777 (RD/B/N-3027) REVIEW OF THE RADIOLYSIS OF METHANE. Norfolk, D. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1975. 29p. Dep. NTIS (US Sales Only) $4.00.

This review of the recent literature has three objectives: to determine the yields of the primary products and to describe the sequence of reactions in which they take part; to ascertain the effect of changes in the physical state of the methane and the quantum energy of the radiation, and of the presence of chemically inert sensitizers; to identify the situation most similar to the adsorbed phase radiolysis of methane on alumina, and so to predict the likely radiolytic reactions in this system. The main primary product yields in methane gas under γ-irradiation are estimated to be $G(CH_4^+) \sim 1.75$, $G(CH_3^+) \sim 1.46$ $G(CH_3) \sim 1.4$ and $G(CH_2) \sim 1.0$. The situation most similar to adsorbed-phase radiolysis is inert gas sensitized photolysis at energies below 12.6 eV. In this system the major primary process is homolytic dissociation of methane to CH_3 + H. 63 references (auth)

22778 ALTERATION OF AN ANNEALED AND IRRADIATED LUNAR FINES SAMPLE BY ADSORBED WATER. Holmes, H. F.; Agron, P. A.; Eichler, E.; Fuller, E. L. Jr.; O'Kelly, G. D.; Gammage, R. B. (Oak Ridge National Lab., Tenn. (USA)). Earth Planet. Sci. Lett.; 28: No. 1, 33-36(Nov 1975).

Apollo 12 lunar fines sample 12070,403 was annealed at 1000°C and subsequently irradiated with a beam of 130 MeV Fe^{9+} ions. Adsorptions of nitrogen and water were measured before and after the irradiation. Prior to the irradiation, the fines were non-porous and water had no effect on the physical characteristics of the lunar fines. In contrast, after the irradiation, the interaction with water caused an increase in the specific surface area and created a pore system. These results are definitive evidence that the interaction of water with damage tracks is the prime factor involved in the alteration of lunar fines by absorbed water. (NL)

22779 RADIOLYSIS OF DECALIN-TBP SOLUTIONS. Giefer, D. L.; Merklin, J. F. (Kansas State Univ., Manhattan (USA). Dept. of Nuclear Engineering). Nucl. Instrum. Methods; 128: No. 3, 609-610(15 Oct 1975).

The radiolysis of decalin-tributylphosphate (TBP) solution has been investigated and a sensitized decomposition of the TBP found. (NL)

22780 COMPARISON OF THE RADIO-INDUCED POLYMERIZATION IN THE TWO CRYSTALLINE FORMS OF SOLID ACRYLONITRILE. Puig, J. R.; Gouloubandi, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Centre d'Application et de Promotion des Rayonnements Ionisants). J. Chim. Phys.; 72: No. 6, 702-708(Jun 1975). (In French)

The two crystalline forms of solid acrylonitrile were irradiated. At -196°C, the low temperature crystals are less reactive than the trapped high temperature crystals, but the initiation yields are practically equal. The trapped high temperature phase is therefore more favorable to the propagation of the reaction. The delayed polymerization reactions lead also to more important reactions in the trapped nigh temperature crystals. The initiation yields were measured in the high temperature phase at -196°C and -110°C and the influence of the irradiation temperature was investigated. The study of the delayed polymerization at different temperatures shows that the initial reaction rate and the maximum conversion increase with the temperature. (FR)

22781 ACCELERATORS AND INHIBITORS OF THE RADIO-INDUCED POLYMERIZATION OF SOLID ACRYLONITRILE. Puig, J. R.; Gouloubandi, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Centre d'Application et de Promotion des Rayonnements Ionisants). J. Chim. Phys.; 72: No. 6, 709-718(Jun 1975). (In French)

The influence of iodine, toluene, hydroquinone, nitrobenzene, isopropanol and propionitrile on the ^{60}Co γ-induced polymerization of solid acrylonitrile was investigated. Under the experimental conditions of the study (irradiation dose of 0.48 Mrad at -110°C; post-polymerization at -85 and -95°C) the following effects were observed: iodine and toluene act as scavengers of the primary species responsible for the initiation of the polymer chains; hydroquinone acts as a chain transfer agent by increasing the number of polymeric chains during the post-polymerization period; Nitrobenzene has no influence; isopropanol and propionitrile increase the polymerization yield. (FR)

22782 ACID-BASE PROPERTIES OF SOME SIMPLE ORGANIC FREE RADICALS. Bell, J. A. Waltham, MA; Brandeis Univ. (1975). 145p. University Microfilms Order No. 75-24,798. Thesis (Ph. D.).

Free radicals were formed at ambient temperatures (22 +- 1°C) by pulse radiolysis of dilute aqueous solutions of the parent compounds: glycolate, glycolamide, and lactamide. Kinetic spectrophotometry was used to observe the radicals. Rate constants for the reaction of the parent compounds with hydrated electrons were measured by the decay of the e^-/sub aq/ absorption. Absorption spectra of the radicals were measured at different pH's, and from the changes with pH, the acid dissociation constants of the radicals were found. The fast formation of the radicals and the differences of the transient absorptions of the acid and base forms of the radicals allowed the deprotonation reactions to be observed. In each case the approach to equilibrium was pseudo-first order. (LK)

22783 THERMAL AND PHOTO-INDUCED PHENOMENA IN gamma-IRRADIATED POLY(METHYL METHACRYLATE). Torikai, A.; Asai, T.; Suzuki, T.; Duri, Z. I. (Univ. Chikusa-Ku, Nagoya, Japan). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 4, 797-805(Apr 1975).

ESR spectra and absorption spectra of gamma-irradiated poly(methyl methacrylate) (PMMA) at 77°K and the photo- and thermal bleaching behavior have been studied. Gamma-irradiation of PMMA yields a singlet spectrum with a line width of 6 G which is bleachable with visible light. This species is assigned to the polymer cation. The unbleached species consists mainly of a four-line spectrum and is assigned to a polymer radical having a different CH_2 conformation from the usual nine-line spectrum. On subsequent warming to room temperature, the spectrum changes into the nine-line spectrum. Gamma-Irradiation of PMMA containing biphenyl as an additive at 77°K gives biphenyl cation. Yield of polymer radical is reduced by the addition of biphenyl and 2-methyltetrahydrofuran. A mechanism is proposed which is consistent with the experimental results. (auth)

22784 RADIOLYSIS OF 1,1-DIMETHYLCYCLOHEXANE. Wojnarovits, L.; Foldiak, G. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 23: No. 4, 257-267(29 Nov 1975).

The yield of hydrogen from irradiated 1,1-dimethylcyclohexane is G = 3.3 whereas that of the elimination of one methyl group is about 0.7. Ring fragmentation has a yield of G ≈ 0.16 and open chain octene formation G ≈ 1.5. C-C bonds break mainly in the vicinity of branching. The G value of hydrogen formation decreases, that of C-C bond fission products increases in the following order: cyclohexane → methylcyclohexane → 1,1-dimethylcyclohexane. Contribution of electron-ion recombination to hydrogen formation becomes lower with increasing branching for both aliphatic and cyclic alkanes: this shift can be attributed to the fact that an increasingly large part of ionization energy is utilized for C-C bond cleavages instead of C-H bond ruptures. (auth)

22785 RADIOLYSIS OF BRANCHED HYDROCARBONS. I. Yield of Gaseous Products in the Radiolysis of 2,3-Dimethylbutane and 2,2-Dimethylbutane in Liquid Phase. Rucinska-Starosta, A.; Karolczak, S.; Kroh, J. (Technical Univ., Lodz, Poland). Radiochem. Radioanal. Lett.; 23: No. 4, 205-211 (29 Nov 1975).

Gamma radiolysis of 2,2- and 2,3-dimethylbutane in liquid phase was studied. Radiation yields of C_1-C_4 hydrocarbons and other gaseous products were determined in the presence of electron scavengers, N_2O and SF_6. The influence of the chemical structure of molecules and degree of sphericity on radiation yields was discussed. (auth)

22786 VALENCE FORMS OF URANIUM IN DISSOLUTION PROCESSES OF γ-IRRADIATED URANIUM OXIDES IN SULFURIC ACID. Gromov, V. V.; Abdulaev, D.; Yatsenko, N. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 635-637(1974).

Translated from Radiokhimiya; 16: No. 5, 646-648(1974)

The effect of preliminary irradiation with γ radiation on the valence state of UO_2 and U_3O_8 on their dissolution by chemically pure H_2SO_4 was studied. During partial oxidation of the oxides an increase in the absorbed dose of UO_2 resulted in a sharp increase in the U(VI)/U(IV) ratio. Preliminary irradiation of U_3O_8 did not affect the ratio of the valence forms. During complete dissolution of the oxides the ratio of the valence forms U(VI)/U(IV) fell. (JSR)

22787 REDOX POTENTIAL OF THE $O_2-O_2^-$ SYSTEM IN AQUEOUS MEDIA. Ilan, Y. A.; Meisel, D.; Czapski, G. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). Isr. J. Chem.; 12: No. 4, 891-895(Aug 1974).

Publ. as a "Note."

O_2^- radicals were formed in the presence of 2,5-dimethyl benzoquinone (DMBQ). The equilibrium constant of the electron

transfer reaction DMBQ + O_2^- ⇌ $DMBQ^-$ + O_2 was determined. From this value and from E^0 (DMBQ/$DMBQ^-$) we calculated the redox potential of the couple O_2/O_2^-, as E^0 (O_2/O_2^-) = −0.33V. (auth)

22788 MICROSECOND REACTIONS. van der Linde, H. J. duT. Nucl. Act.; No. 13, 27-29(Jul 1975).

The use of the pulse irradiation technique for studying fast reactions is considered. Identification of the solvated electron is the most important discovery made with this technique. Application of fast reaction kinetics in the radiobiological field is discussed. (LK)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 23652–23654.

22789 SYNTHESIS OF ^{14}C-LABELLED ISOTOPE-ISOMERIC ALKANES. II. Preparation of 2,2,4-Trimethylpentane-$^{14}C_2$ Labelled at Both Methyl Groups of the Isopropyl Moiety. Bally, I.; Balaban, A. T. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Chim.; 20: No. 11-12, 1471-1472(1975). (In French).

The preparation of isooctane labelled with ^{14}C at both methyl groups of the isopropyl moiety is described, starting from ethyl t-butylacetate and ^{14}C-methylmagnesium iodide. (auth)

Hot-Atom Chemistry

22790 THEORETICAL INTERPRETATION OF FRAGMENTATION PATTERNS OF TRITIATED ALKANES AFTER β-DECAY. Ikuta, S.; Okuno, K.; Yoshihara, K.; Shoikawa, T. (Tohoku Univ., Sendai). Radiochem. Radioanal. Lett.; 23: No. 4, 213-219(29 Nov 1975).

Fragmentation mechanisms of tritiated alkanes after the β decay, T → $^3He^+$, were quantitatively studied on the basis of an internal energy distribution of R^+ calculated by the CNDO/2 method, and a fragment ion distribution of R· obtained experimentally. (auth)

Properties of Radioactive Materials

Refer also to abstracts 22722, 22729, 22748–22752, 22773, 22786, 23281, 23611, 23625, 23682, and 23766.

22791 (PB-240955) RADIOACTIVITY STANDARDS DISTRIBUTION PROGRAM, 1973–1974. Environmental Monitoring Series. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1974. 21p. (EPA-680/4-73-001). NTIS $3.25.

A program for the distribution of calibrated radioactive samples is described. Included is a discussion of the objectives of the distribution program and a description of the preparation, availability, and distribution of calibrated radioactive samples. Instructions and application forms are included for laboratories desiring to participate in the program. This document is not a research report. It is designed for use by personnel of laboratories participating or desiring to participate in the Radioactivity Standards Distribution Program which is a part of the U. S. Environmental Protection Agency's quality assurance program. (GRA)

22792 (PB-240962) ENVIRONMENTAL RADIOACTIVITY LABORATORY INTERCOMPARISON STUDIES PROGRAM, 1973–1974. Environmental Monitoring Series. (National Environmental Research Center, Las Vegas, Nev (USA)). Feb 1974. 27p. (EPA-680/4-73-001). NTIS $3.75.

The U. S. Environmental Protection Agency's intercomparison studies program for laboratories involved in environmental radiation measurements is described. The types of environmental samples distributed, the analysis required for each sample, the distribution schedule, and the statistical analysis and reporting of results are discussed. Instructions and application forms are included for laboratories desiring to participate in the program. This document is not a research report. It is designed for use by laboratories participating or desiring to participate in this quality assurance program. (GRA)

22793 ADSORPTION BEHAVIORS OF PROTACTINIUM-233 ON SILICA GEL IN NITRIC ACID MEDIUM. Chang, H. P.; Ting, G. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 3, 119-132(Sep 1975).

The effect of nitric acid concentration (0.5 to 10M) on the adsorption behavior of protactinium-233 on silica gel has been examined. It has been found that distribution coefficients were dependent on the sources and the mean pore size of the silica gel. The adsorption rate in the absence and presence of thorium was studied. At 10M HNO_3, the distribution coefficient of protactinium on silica gel decrease with increasing thorium concentration (D.C. = 6082 at 0g Th/l, D.C. = 2426 at 200 g Th/l. For the practical application of the results to thorium fuel reprocessing, the effect of hydrofluoric acid concentration (0 to 0.04M) and aluminum concentration (0 to 0.4M) on the adsorption were investigated. The temperature effect on the adsorption has also been examined, which indicates that the adsorption reaction is an exothermic reaction. Based on the experimental results, the adsorption mechanism has been tentatively proposed. (auth)

22794 TRIFLUOROMETHYLSULFONATE COMPLEXES OF URANYL. Skoblo, A. I.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 510-513(1974).

Translated from Radiokhimiya; 16: No. 4, 518-521(1974).

In the investigation of the system $UO_2(CF_3SO_3)_2$–$R_4NCF_3SO_3$–nonpolar solvent by IR spectroscopy it was established that the complexes $R_4N[UO_2(CF_3SO_3)_3]$, $(R_4N)_2[UO_2(CF_3SO_3)_4]$ and $(R_4N)_3[UO_2(CF_3SO_3)_5]$ with coordination number of UO_2^{2+} = 6, 4, and 5, respectively, are formed. With the neutral ligand trioctylphosphine oxide the uranyl sulfonate forms the complexes $UO_2(CF_3 \cdot SO_3)_2(TOPO)_2$, $UO_2(CF_3SO_3)_2 \cdot TOPO$ and $[UO_2(TOPO)_5] \cdot (CF_3SO_3)_2$ with coordination number of UO_2^{2+} = 5. (auth)

22795 SPECTRA OF URANYL COMPOUNDS IN THE VISIBLE REGION. Skoblo, A. I.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 514-516(1974).

Translated from Radiokhimiya; 16: No. 4, 522-524(1974).

A measurement of the spectra of a series of uranyl compounds in the visible region showed a relationship between the position of the vibration bands and the structure of the complex, between the intereffect of ligands in mixed complexes and the position of the maxima, and a relation between the symmetry of the complex and the position of the maxima. In uranyl compounds without a center of symmetry two forms of electronic spectra were observed which differ substantially from each other. The cause for these two spectra may be related to the different characters of the π interaction of the ligands with the uranyl ion. (JSR)

22796 OXIDATION OF URANIUM DIOXIDE. Chumachkova, V. D.; Lavut, E. G.; Dunaeva, K. M.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 540-542(1974).

Translated from Radiokhimiya; 16: No. 4, 548-551(1974).

The oxidation of uranium dioxide, prepared by reduction of the γ-modification of uranium trioxide at 500°, was investigated. The temperature range investigated was 120-200°. (LK)

22797 OXIDATION-REDUCTION REACTIONS OF ACTINIDE ELEMENTS. XXVI. Kinetics of the Reactor of Uranium (IV)–Americium (V) in Perchlorate Solutions. Blokhin, N. B.; Ermakov, V. A.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 543-544(1974).

Translated from Radiokhimiya; 16: No. 4, 551-553(1974).

The kinetics of the reaction uranium (IV)–americium (V) were studied by a spectrophotometric method. The standard thermodynamic parameters of the activation of the reaction are Gibbs free energy (15.2 ± 0.2 kcal/mole), enthalpy (18 ± 1 kcal/mole), and entropy (9 ± 3 entropy units). Over the range of experimental conditions studied the oxidation of uranium (IV) by americium (V) is characterized by a decrease in rate with an increase in acidity and a positive standard entropy of activation. These are characteristic of "hole" oxidation-reduction reactions. (LK)

22798 KINETICS OF THE REACTION NEPTUNIUM (V)–AMERICIUM (V) IN SODIUM CARBONATE SOLUTIONS. Chistyakov, V. M.; Ermakov, V. A.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 545-547(1974).

Translated from Radiokhimiya; 16: No. 4, 553-555(1974).

Results of a spectrophotometric investigation of the kinetics of the reaction neptunium (V)–americium (V) in sodium carbonate solutions are given. The effective activation energy of the reaction is independent of the sodium carbonate concentration within the limits of experimental error and is 14.5 ± 1.0 kcal/mole. (LK)

22799 SPECTROPHOTOMETRIC STUDY OF THE REACTION OF NEPTUNIUM (V) IONS WITH INDIUM (III) IONS. Frolov, A. A.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 548-549(1974).

Translated from Radiokhimiya; 16: No. 4, 556-557(1974).

The change in the absorption spectrum of Np(V) in the presence of In(III) indicates that in this system Np(V) exists in only two spectrally distinguishable forms. One is the free form and the second is the bound form. The equations describing the conversion from the free to the bound form are given. The parameter describing the degree of cation–cation interaction in the system is closer than the analogous values for the systems Np(V)–U(VI), Np(V)–Fe(III), and Np(V)–Th(IV). The degree of interaction of

Np(V) with "active" cations is higher when the probability of the transfer of an electron from the solvent to the "active" cation is greater. (JSR)

22800 EFFECT OF TEMPERATURE ON THE REACTION OF URANIUM WITH ALKALI METAL FLUORIDES. Kashcheev, I. N.; Novoselov, G. P. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 550-551(1974).

Translated from Radiokhimiya; 16: No. 4, 557-559(1974).

The temperature dependences of the rate of reaction of uranium with melts of KF and LiF–KF and LiF–CaF_2 mixtures were found. It was established that at temperatures up to 1100°C in an LiF–KF melt the uranium reacts with the potassium fluoride. At temperatures above 1100°C in an LiF–CaF_2 melt the uranium reacts with the lithium fluoride. It was established that in LiF–KF and LiF–CaF_2 melts the rate of reaction is limited by diffusion of the reaction components in the salt melts. (auth)

22801 STATE OF MICROAMOUNTS OF YTTRIUM-91 IN AQUEOUS SOLUTIONS CONTAINING ALBUMIN. Mikshevich, N. V.; Kuptsova, V. V.; Semenov, D. I.; Egorov, Yu. V.; Puzako, V. D. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 552-554(1974).

Translated from Radiokhimiya; 16: No. 4, 559-562(1974).

A study was made of the state of microamounts of yttrium-91 in aqueous solutions of albumin by the foam formation method. The relation of the extraction of the microcomponent into the foam to the pH is complex and this is connected with the state of both the protein and the isotope. It was shown that there are exchange processes in the interaction of the radionuclide with the protein molecule in a weakly acid medium. In neutral and weakly alkaline media, there is a substantial fraction of colloidal forms of ^{91}Y which are complex in nature. In the region of neutral and weakly-alkaline media, forces of an electrostatic nature determine the character of the interaction in the system studied. A low affinity of yttrium for the given preparation of albumin was observed. (auth)

22802 SYNTHESIS OF ISOTOPICALLY PURE METHANE C^3H_4. Leonov, V. V.; Sinotova, E. N.; Korsakov, M. V. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 557-559(1974).

Translated from Radiokhimiya; 16: No. 4, 564-566(1974).

Conditions were developed for the synthesis of methane C^3H_4 of 97% isotopic purity. A method was used for the first time to free methane C^3H_4 from unreacted tritium by coprecipitation of methane with solid xenon at –196°C. A very simple method was developed for RGC analysis of the isotopic purity of methane C^3H_4 at room temperature with highly efficient activated charcoal PAU-1 as the sorbent. (auth)

22803 AQUEOUS ALCOHOL SOLUTIONS OF URANYL NITRATE. I. Polarographic Investigation of Aqueous Ethanol Solutions. Kanevskii, E. A.; Pavlovskaya, G. R.; Rengevich, V. B. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 457-461(1974).

Translated from Radiokhimiya; 16: No. 4, 464-469(1974).

The half-wave potential of the reduction $U^{(VI)} \rightarrow U^{(V)}$ in aqueous ethanol solutions is shifted toward the negative side with an increase in the alcohol concentration up to ~80%. The shift in the half-wave potential reaches –60 mV in a solution in 81.1 wt.% C_2H_5OH in comparison with an aqueous solution. With an increase in the alcohol concentration the shift in the half-wave potential of Tl^+ in aqueous solutions occurs in the opposite direction and reaches +115 mV in 100% C_2H_5OH in comparison with the aqueous solution. The behavior of Tl^+ in aqueous ethanol solution is normal for ions whose hydration energy is higher than the solvation energy. Possible reasons for the observed changes in the half-wave potential of $U^{(VI)} \rightarrow U^{(V)}$ are discussed. (auth)

22804 AQUEOUS ALCOHOL SOLUTIONS OF URANYL NITRATE. II. Polarographic Investigation of Aqueous Methanol Solutions. Kanevskii, E. A.; Pavlovskaya, G. R.; Rengevich, V. B. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 462-464(1974).

Translated from Radiokhimiya; 16: No. 4, 469-471(1974).

An investigation was made of the reduction $U^{(VI)} \rightarrow U^{(V)}$ in aqueous methanol solutions. The relation of the half-wave potential to the methanol concentration passes through a minimum at an alcohol content of ~88 wt.%. This form of relation explained hypothetically by the formation of a mixed complex, which is more stable than the hydrated ion $UO_2(H_2O)_n^{2+}$ and the solvate of $U^{(VI)}$ formed in absolute CH_3OH. The results of investigating the reduction $U^{(VI)} \rightarrow U^{(V)}$ in aqueous methanol and aqueous ethanol solutions are compared. (auth)

22805 AQUEOUS ALCOHOL SOLUTIONS OF URANYL NITRATE. III. Spectrophotometric Investigation of Aqueous Methonol Solutions with a Low Water Content. Kanevskii, E. A.; Pavlovskaya, G. R.; Rengevich, V. B.; Ponomareva, S. I. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 465-469(1974).

Translated from Radiokhimiya; 16: No. 4, 472-476(1974).

A spectrophotometric investigation was made of 0.01 M solutions of uranyl nitrate in aqueous methanol with H_2O concentrations in the range of 0-5.5 M. It was shown that a mixed complex compound is formed with one molecule of water in the coordination sphere. Pominov's method for determining the equilibrium constant with the formation of mixed complexes in aqueous–nonaqueous solutions was refined. The method proposed makes it possible to determine both the equilibrium constant and also the ratio of the molar absorption coefficient of the mixed complex ϵ_1 to the molar absorption coefficient of the complex containing no water molecules. It was established that the equilibrium constant of UO_2^{2+} m$_1$ $CH_3OH + H_2O \rightleftharpoons UO_2^{2+}$ m $CH_3OH \cdot H_2O + CH_3OH$ = 6.0 ± 0.14 (P = 0.95). (auth)

22806 REACTION OF URANYL NITRATE AND SULFATE WITH γ-BUTYROLACTONE. Nikol'skaya, L. E.; Zelentsov, S. S. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 470-474(1974).

Translated from Radiokhimiya; 16: No. 4, 476-481(1974).

The complex compounds were prepared from uranyl nitrate and sulfate with γ-butyrolactone (γ-bl), an organic ligand in the cyclic ester class. It was shown that in the crystalline compounds isolated, $UO_2(NO_3)_2 \cdot 2\gamma\text{-bl}$ and $UO_2SO_4 \cdot \gamma\text{-bl} \cdot (1\text{-}2H_2O)$, of the two oxygen atoms in the γ-bl the carbonyl group oxygen is directly responsible for the donor–acceptor interaction with the uranyl. It was found that the cyclic structure of the γ-bl affects the state of the nitro group in the coordination sphere. (auth)

22807 REACTION OF URANYL HALIDES WITH γ-BUTYROLACTONE. Nikol'skaya, L. E.; Zelentsov, S. S. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 475-478(1974).

Translated from Radiokhimiya; 16: No. 4, 481-486(1974).

It was found that uranyl halides (chloride, bromide, and fluoride) undergo an acceptor interaction with γ-butyrolactone (γ-bl) to form an uncrystallizable substance of complex character. From the chemical properties and IR spectra of the substances obtained it was observed that in the coordination interaction of γ-bl with uranyl there is a shift in the tautomeric equilibrium toward the formation of the enol form of γ-bl. It is suggested that there are three types of ester–uranyl bonds in the complex systems obtained, which contain the enol form of the lactone: (1) a donor–acceptor bond of γ-bl–uranyl through the oxygen of the C = O group; (2) a donor–acceptor bond of enol–uranyl through the oxygen of the enol OH group; and (3) a hydrogen bond between the OH of the enol and the oxygen of the carbonyl group or the ether oxygen of γ-bl. (auth)

22808 KINETICS OF THE REACTION OF PLUTONIUM IONS WITH TETRAVALENT URANIUM IN NITRIC ACID SOLUTION. I. Reduction of Pu(IV). Marchenko, V. I.; Koltunov, V. S. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 479-484(1974).

Translated from Radiokhimiya; 16: No. 4, 486-492(1974).

A study was made of the reaction between $Pu^{(IV)}$ and $U^{(IV)}$ in a solution of $HNO_3 + NaNO_3$ with an ionic strength $\mu = 2$ over the range $[H^+] = 0.48\text{–}2.0$ M at temperatures of 10.0, 14.8, and 25.5°C. The stoichiometry of the reaction is given by the equation $2Pu^{4+} + U^{4+} + 2H_2O = 2Pu^{3+} + UO_2^{2+} + 4H^+$. The rate of the reaction is described by the equation $-d[Pu^{IV}]/dt = k[Pu^{(IV)}]\,[U^{(IV)}]/[H^+]^{1.5}$, where $k = 1800 \pm 50$ $M^{0.5} \cdot min^{-1}$ at 25.0°C. The activation energy in 2 M HNO_3 is 25.4 ± 0.5 kcal/mole. An increase in the concentration of NO_3^- (in a solution of $HClO_4 + HNO_3$) leads to retardation of the reaction. In the presence of SO_4^{2-} and Fe^{3+} ions the reaction is accelerated. It is suggested that the reaction proceeds by two parallel routes with the participation of hydrolyzed $Pu^{(IV)}$ and $U^{(IV)}$ ions. An equation for the rate is given that takes this mechanism into account. The thermodynamic activation parameters were calculated for these reaction routes. (auth)

22809 KINETICS OF THE REACTION OF PLUTONIUM IONS WITH TETRAVALENT URANIUM IN NITRIC ACID SOLUTION. II. Reduction of Pu(VI) to Pu(V). Marchenko, V. I.; Koltunov, V. S. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 485-488 (1974).

Translated from Radiokhimiya; 16: No. 4, 492-496(1974).

A study was made of the kinetics of reduction of $Pu^{(VI)}$ to $Pu^{(V)}$ by uranium (IV) in a solution of $HNO_3 + NaNO_3$ with an ionic strength $\mu = 2$ in the range of $[H^+] = 0.74\text{–}2$M at temperatures of 12-25°C. The reaction rate is described by the equation $-d[Pu^{(VI)}]/dt = k[Pu^{(VI)}][U^{(IV)}]/[H^+]^{1.2}$, where $k = 1150 \pm 60$ $M^{0.2} \cdot min^{-1}$ with $\mu = 2$ at 25°C. From the temperature dependence we determined the activation energy (E = 17.7 kcal/mole) and the thermodynamic parameters of the activation of the reaction ($\Delta H^* = 17.1$ kcal/mole, $\Delta F^* = 15.7$ kcal/mole, and $\Delta S^* = 4.7$ entropy units). With an increase in the concentration of NO_3^- ions in the system $HNO_3 + HClO_4$ ($\mu = 2$) the reaction rate passes through a maximum when $[NO_3^-] \simeq 1$ M. It was concluded that the reaction of $Pu^{(VI)}$ and $U^{(IV)}$ proceeds by two parallel routes, whose rates depend differently on the concentration of H^+ ions. (auth)

22810 KINETICS OF THE REACTION OF PLUTONIUM IONS WITH TETRAVALENT URANIUM IN NITRIC ACID SOLUTION. III. Reduction of Pu(V). Marchenko, V. I.; Kiltunov, V. S. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 489-494(1975).

Translated from Radiokhimiya; 16: No. 4, 496-502(1974).

A study was made of the reduction of $Pu^{(VI)}$ and $Pu^{(V)}$ to $Pu^{(III)}$ by uranium (IV) in solutions of HNO_3 + $NaNO_3$ with an ionic strength μ = 2 over the range of $[H^+]$ = 0.47–2.1 M at temperatures of 6.5 to 35°C. The stoichiometry of the overall reaction is represented by the equation $2PuO_2^{2+} + 3U^{4+} + 2H_2O = 2Pu^{3+} + 3UO_2^{2+} + 4H^+$. The reduction of $Pu^{(VI)}$ proceeds in two successive stages: the $Pu^{(VI)}$ is first converted rapidly into $Pu^{(V)}$, which is then converted more slowly into $Pu^{(III)}$. The rate of the last reaction is given by $-d[Pu^{(V)}]/dt = k[Pu^{(V)}][U^{(IV)}]$, where k = 80.0 ± 11.0 $M^{-1} \cdot min^{-1}$ with $[NO_3^-]$ = 2 M, μ = 2 at 25.0°C. The activation energy of this reaction is 17.8 kcal/mole, the enthalpy of activation ΔH^* = 17.2 kcal/mole, the entropy ΔS^* = −0.3 entropy units, and the free energy ΔF^* = 17.3 kcal/mole (at 25°C). The reaction mechanism is discussed and it is proposed that an H or O atom is transferred in the slow stage. (auth)

22811 EFFECT OF NITRATE IONS, THE NATURE OF THE "NEUTRAL" CATIONS, AND TEMPERATURE ON THE POTENTIAL OF THE PLUTONIUM(IV)–PLUTONIUM(III) COUPLE. Simakin, G. A.; Rykov, A. G.; Baklanova, P. F. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 495-499(1974).

Translated from Radiokhimiya; 16: No. 4, 502-507(1974).

The decrease in the normal oxidation-reduction potential of the $Pu^{(IV)}-Pu^{(III)}$ couple in the region of medium concentrations of nitrate ions is probably not connected with the formation of inner-sphere nitrate complexes of tetravalent plutonium, but is produced by an increase in the electron-donor power of the water molecules in the first coordination sphere of the Pu^{4+} ion and an increase in the heat of hydration (or the covalence of the water-cation bond). The increase in the maximum shift in the potential of this couple in the presence of positively hydrated cations in the series Na^+, H^+, Li^+, Al^{3+} may be explained by strengthening of the hydrogen bonds between the nitrate ion and water molecules in the hydration envelope of tetravalent plutonium. The positive temperature coefficient for the electrode process $Pu_{aq}^{4+} + H^+ \rightleftharpoons Pu_{aq}^{3+} + 1/2H_2$ in a solution with the composition $(1-x)MHClO_4 + xMHNO_3$(x = 0.4, 0.5 M) is connected with the anomalous nature of the hydrogen ion. (auth)

22812 RELATION OF THE STABILITY OF COMPLEXES OF RARE EARTH ELEMENTS AND THORIUM WITH ORGANOPHOSPHORUS ACIDS TO THE STRUCTURE OF THESE ACIDS. Guseva, N. N.; Karapet'yants, M. Kh.; Mikhailichenko, A. I.; Sklenskaya, E. V. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 500-503(1974).

Translated from Radiokhimiya; 16: No. 4, 508-511(1974).

For 17 organophosphorus acids we found a correlation of the ionization constants and the stability constants of complexes of lanthanum, ytterbium, and thorium, based on the Hammett equation with the use of the Kabachnik constants σ^{ph} which characterize the induction and resonance effects of the substituent groups at the phosphorus atom. It was found that in the case of complex formation of organophosphorus acids with metals the contribution of the resonance effect to the value of σ^{ph} is greater than in the ionization of acids. For most of the acids studied the constants σ^{ph} were determined and the induction σ_I^{ph} and resonance σ_R^{ph} components were calculated. (auth)

22813 COMPLEXES OF URANYL WITH ANIONS OF SALTS OF UNSTABLE ACIDS. Sles, V. G.; Skoblo, A. I.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 504-509(1974).

Translated from Radiokhimiya; 16: No. 4, 512-518(1974).

In the system uranyl–tetradecylammonium cyanate the anionically saturated complex is $(R_4N)_2[UO_2(NCO)_4]$, in which the cyanate groups are coordinated to the uranyl through the nitrogen atoms and the coordination number of UO_2^{2+} equals 4. With the nitrite ion uranyl forms the complexes $R_4N[UO_2(ONO)_3]$ and $(R_4N)_2[UO_2(ONO)_4]$ with coordination number of UO_2^{2+} equal to 4 and in the latter all the nitrite groups are coordinated to the uranyl ion through one oxygen atom. In the complex $K_2[UO_2(SO_3)_2]$ the coordination number of UO_2^{2+} equals 4 and the sulfite group is coordinated bidentately. (auth)

22814 VALENCE OF ACTINIDES AND TRANSACTINIDES FROM THE POINT OF VIEW OF D. I. Mendeleev's Periodic Law. Spitsyn, V. I. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 650-652(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 659-662(1974).

On the basis of a qualitative examination of the valence behavior of the transition elements of the first three long periods in the periodic table, an evaluation is made of the probable and possible valence states of the actinide and transactinide elements. The evaluation indicates that element 103 and heavier elements will not only have the oxidation states corresponding to Groups III, IV, and V, but also higher and lower values, depending on the redox potential of the medium in which they are present. (JSR)

22815 POSITION OF THE TRANSURANIUM ELEMENTS IN THE PERIODIC SYSTEM. Nesmeyanov, An. N. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 653-656(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 662-666(1974).

The electronic structure and properties of Th, Pa, U, and the transuranium elements were compared with those of Hf, Ta, W, Re, and Os and with the lanthanides. The analysis showed the dual nature of U, Pa, and Th in that they are similar to the corresponding lanthanides with respect to their properties in the elemental state and the lower valence states, whereas in the higher oxidation states they are similar to the d elements of the 6th period. Some similarity is observed between Np in the highest oxidation state and Re, but all the subsequent elements are similar only to the lanthanides. (JSR)

22816 COCRYSTALLIZATION AND ADSORPTION METHODS IN THE STUDY OF THE CHEMICAL PROPERTIES OF ULTRAMICROAMOUNTS OF TRANSURANIUM ELEMENTS. Mikheev, N. B. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 667-674(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 677-686(1974).

It is now possible to state with certainty that the cocrystallization method is a reliable method of identifying the valence state of the remote transuranium elements. Moreover, the cocrystallization method may be the only possible method of determining the oxidation state of these elements if a medium of nonaqueous solvents is used, especially when the oxidation state of the microelement identified is unstable. The cocrystallization method is a method of determining a series of physicochemical constants of compounds of transuranium elements which cannot be obtained in weighable amounts, especially in studying their nonaqueous solutions. The cocrystallization method is the only method of determining the solubility product of compounds of these elements and also makes it possible to determine their vapor pressures. (auth)

22817 BOND STRENGTHS IN -YL IONS OF ACTINIDES(VI). Vdovenko, V. M.; Vodovatov, V. A.; Mashirov, L. G.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 704-708(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 716-720(1974).

The force constants of the M–O bond for neptunyl, plutonyl, and americyl were calculated from measurements of the ir spectra of a series of their complexes in which approximately 50% of the ^{16}O had been replaced by ^{18}O. The tabulated data show that with a change from one type of complex to the other the change in the frequencies of the valence vibrations of MO_2^{2+} is similar for all metals, in a series of identical complex the frequency ν_{as} is less sensitive to a change in M than ν_s, and the strength of the M–O bond decreases from U to Am. The values of the force constants calculated agree well with published data. The nature of the uranyl-like bonds is considered and the reasons for the decrease in the strength of the M–O bond are developed; the primary reason being the successive stabilization of the atomic orbitals with the result that the unpaired electrons do not screen the increasing charge of the nucleus sufficiently. (JSR)

22818 THERMODYNAMICS OF CATION–CATION OXIDATION-REDUCTION REACTIONS OF URANIUM AND TRANSURANIUM ELEMENTS. Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 729-734(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 741-747(1974).

Available experimental data on the thermodynamics of some cation-cation reactions of U, Np, Pu, and Am are analyzed in order to determine how the thermodynamic parameters of activation change within a family of reactions of one element and to determine what correlations exist between the thermodynamic activation parameters of such reactions and the thermodynamic properties of reagent cations. (JSR)

22819 EXISTENCE OF NEPTUNOSONEPTUNIC OXIDE. Belyaev, Yu. I.; Solntsev, V. M.; Kapshukov, I. I.; Sudakov, L. V.; Chistyakov, V. M. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 735-738(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 747-752(1974).

The methods of preparing Np_3O_8 by decomposition of $Np^{(V)}$ and $Np^{(VI)}$ compounds in air or in a stream of NO_2 which were described previously in the literature actually lead to the formation of Np_2O_5 or a mixture of Np_2O_5 and NpO_2. The crystal lattice of Np_2O_5 obtained by thermal decomposition of $Np^{(V)}$ and $Np^{(VI)}$ compounds has an orthorhombic lattice with a slight monoclinic distortion and the parameters a = 6.582 ± 0.003 Å, b = 4.086 ± 0.002 Å and c = 4.182 ± 0.002 Å. The existence of another phase with these cell parameters and a composition in the region of $NpO_{2.63}$–$NpO_{2.67}$ (phase of Np_3O_8) is not confirmed. Oxides with the composition $NpO_{2.58}$–$NpO_{2.75}$ consist of two phases. (auth)

22820 OXIDATION-REDUCTION REACTIONS OF ACTINIDES. XXVIII. Effect of Neutral Salts on the Rate of Neptunium(IV)–Iron(III) and Neptunium(V)–Iron(II) Reactions. Rykov, A. G.; Frolov, A. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 561-565(1974).

Translated from Radiokhimiya, 16: No. 5, 569-574(1974).

It was established that an increase in the concentration of alkaline earth and lanthanum (neutral cations) perchlorates leads to a decrease in the rate of the neptunium (IV)–iron (III) reaction and an increase in the rate of the neptunium (V)–iron (II) reaction. The data obtained do not agree with theories which relate the change in the rate of oxidation–reduction reactions on addition of neutral salts to the change in the activity coefficients of reagent cations. An empirical relation was proposed which describes the experimental data satisfactorily. (auth)

22821 SPECTROPHOTOMETRIC STUDY OF COMPLEX FORMATION AND SOLVATION OF ACTINIDE IONS. VIII. Forms of Existence of Uranium(IV) in Systems HNO_3–Water–Nonelectrolyte. Vasil'ev, V. Ya.; Andreichuk, N. N.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 583-586(1974).

Translated from Radiokhimiya; 16: No. 5, 592-596(1974).

The results obtained on the whole agree with the consequences of the model proposed previously for the reaction of nitrate groups with uranium (IV) ions: in mixed solvents, where the concentration of the organic component does not exceed 30 vol. % and a single system of intermolecular hydrogen bonds is preserved, the uranium (IV) exists only in the form of geometrical isomeric aquo complexes. All the basic rules for the conversion of one form into the other, which were established previously for aqueous solutions, are preserved in this case. The introduction of a nonelectrolyte into solutions with a low water content or an increase in its concentration above 30 vol. %, i.e., a change to solutions where the breakdown of the single system of intermolecular hydrogen bonds begins, leads to the formation of a hexanitrate complex of uranium (IV). It was established that in solutions with a concentration of nitric acid no higher than 1 M and a high content of the organic solvent a hydrolyzed form of aquo complex is formed together with the hexanitrate complex and the degree of formation of the former is higher than in aqueous solutions with the same analytical concentration of nitric acid. (auth)

22822 CALCULATION OF DEGREE OF LIBERATION OF RADIOACTIVE GASES FROM SOLIDS AND DETERMINATION OF DIFFUSION COEFFICIENTS. Kapustin, O. A.; Zaborenko, K. B. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 601-606(1974).

Translated from Radiokhimiya; 16: No. 5, 611-617(1974).

Solutions are given for differential equations for the liberation of radium emanation from spherical solids. An examination was made of steady-state and nonsteady-state solutions and approximations are given which make possible a numerical solution for a series of cases encountered in practice. (auth)

22823 CALCULATION OF THE DEGREE OF LIBERATION OF RADIOACTIVE GASES FROM CYLINDRICAL SOLIDS AND DETERMINATION OF THE DIFFUSION COEFFICIENTS. Kapustin, O. A.; Zaborenko, K. B. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 607-613(1974).

Translated from Radiokhimiya; 16: No. 5, 618-625(1974).

A solution is given for the differential equation which describes the liberation of emanation from a limited solid in the form of a cylinder containing isotopes of radium. Steady-state and nonsteady-state conditions were examined. Approximations are given which provide numerical solutions for single crystals or tablets of substances investigated which are used in practice. (auth)

22824 INVESTIGATION OF THE DIFFUSION MOBILITY OF ^{220}Rn IN THORIUM BY THE EMANATION METHOD. Zaborenko, K. B.; Os'kina, T. E.; Chernova, N. A. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 614-617(1974).

Translated from Radiokhimiya; 16: No. 5, 625-629(1974).

It was established that there is a correlation between self-diffusion and ^{220}Rn diffusion parameters in the thorium lattice and this made it possible to use the emanation method to find the Tamman temperature T_T = 950°K, to separate out energetically nonequivalent temperature sections with different diffusion mobilities, and to determine more accurately the phase transition point of thorium from a face-centered to a body-centered cubic structure (1630°K). By the emanation method it was shown that thorium belongs to the group of metals with anomalously low diffusion parameters in the high-temperature phases. By means of the emanation method we obtained the temperature dependence of the diffusion coefficient of ^{220}Rn in a face-centered cubic lattice of thorium with an activation energy of 61 ± 9 kcal/g-atom for P = 0.95 with f = 11, which is considerably lower than the activation energy of self-diffusion of thorium. A hypothesis is put forward on the charge of diffusing radon in thorium. It was shown that the change in the surface must be taken into account in the calculation of the diffusion parameters of an inert gas in a solid by the emanation method. (auth)

22825 STATE OF RADIOIODINE IN METHANOL SOLUTIONS OF FORMIC ACID. Volkov, A. A.; Filatov, E. S.; Nesmeyanov, An. N. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 618-622(1974).

Translated from Radiokhimiya; 16: No. 5, 629-634(1974).

The state of ^{131}I in methanol solutions of formic acid was studied in the pH region of 0.25 to 5.0 by sorption, electrodialysis, and sphetrophotometry. The determination of the sorption by various materials, the migration kinetics, and the change in the optical density in relation to the pH led to the following conclusions on the state of iodine. No positively charged ions are formed and the spectrometric study shows only the presence of I_3^-. In the pH region from 1 to 3 iodine forms compounds with no charge and with a hydrocarbon part. At least two forms of the molecules are produced. (JSR)

22826 REACTION OF URANIUM DIOXIDE AND URANOSO-URANIC OXIDE WITH SODIUM MOLYBDATE. Prokoshin, A. D.; Ustinov, O. A.; Andrianov, M. A.; Chebotarev, N. T.; Lukoyanov, V. M. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 632-634(1974).

Translated from Radiokhimiya; 16: No. 5, 643-645(1974).

The reaction of UO_2 in an inert atmosphere and of U_3O_8 in air with Na_2MoO_4 at 1000°C and the solubility of UO_2 and $Na_2U_2O_7$ (produced by the reaction of U_3O_8 with the molybdate) in a molybdate melt at 700 to 1000°C were studied. Solubility curves show that the solubility of the dioxide and diuranate increases with temperature. The phase compositions of U_3O_8–Na_2MoO_4 mixtures at 700°C were determined with increase of the U_3O_8 content and the calculated interplanar distances for the diuranate were compared with literature values. (JSR)

22827 MONOURANATE IN CESIUM DIURANATE. Kovba, L. M.; Murav'eva, I. A.; Orlova, A. S. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 638-639(1974).

Translated from Radiokhimiya; 16: No. 5, 648-650(1974).

Single phase preparations of Cs_2UO_4 in $Cs_2U_2O_7$ were prepared by calcining ground mixtures of Cs_2CO_3 and U_3O_8 at temperatures from 400 to 500°C. X-ray diffraction patterns were obtained. The structure previously proposed for Cs_2UO_4 was verified for the most part. The x-ray diffraction data for the diuranate are tabulated and the lattice parameters were determined. The diuranate crystallized in the hexagonal syngony, but the hexagonal uranyl oxygen layers, the main structural elements, are arranged in a pattern of closest hexagonal packing. (JSR)

22828 SOME ASPECTS OF THE THERMAL DECOMPOSITION OF AMMONIUM POLYURANATE MICROSPHERES. Breshci, R.; Olivi, A. (Centro Applicazioni Militari Energia Nucleare, S. Piero a Grado (Italy)); Camanzi, A. (AGIP Nucleare, Milan (Italy)). Energ. Nucl. (Milan); 21: No. 5, 287-290(1974).

Results are given of an investigation on ammonium polyuranate microspheres contracting by isothermal heating up to 500°C by a hot stage microscope. The percent change of diameters versus time at different temperatures is interpreted as a nucleation and growth process of different phases of decomposition; an interface of decomposition, separating product and reactant phases, advances toward the microsphere center with a process governed by diffusion of decomposition gases. (INIS)

22829 ION CYCLOTRON RESONANCE STUDIES OF ENDOTHERMIC REACTIONS OF UF_{-6} GENERATED BY SURFACE IONIZATION. Beauchamp, J.L. (Contribution No. 5164 from the Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). J. Chem. Phys. 64: No. 3, 929-935 (1 Feb 1976).

Ion cyclotron resonance spectroscopy is used to investigate endothermic reactions of UF_{-6}. At temperatures below those required for electron emission, UF_{-6} is formed by negative surface ionization on a directly heated rhenium filament. The reactant ion is accelerated to a known energy and traverses the source region of the ICR cell in the direction of the magnetic field. Slow products from reactive and nonreactive encounters are confined in the trapping well and detected in the usual manner. The formation of UF_{-7}, UF_{-6}, UF_{-5}, and UF_{-3} from the reaction of UF_{-6} with UF_6 is studied over the energy range

0-40 eV in the center of mass. The cross section for UF^-_7 formation exhibits a threshold at a relative kinetic energy of 2.7 eV. Reaction of UF^-_6 with BF_3 leads to formation of BF^-_4 with a threshold of 1.6 eV in the center of mass. From these thresholds, E.A.(UF_6) $=4.9\pm0.5$ eV is deduced and the bond dissociation energies D (UF_5-F^-) $=108\pm6$ kcal/mole and D (UF_6-F^-) $=46\pm10$ kcal/mole are calculated. The endothermic reaction of UF^-_6 with SF_6 to produce SF^-_6 is also investigated, the cross section for the process exhibiting a gradual onset at ~7.5 eV, considerably above the thermodynamic threshold. The experimental techniques for using ion cyclotron resonance spectroscopy to study endothermic reactions of positive and negative ions formed by surface ionization are considered in detail. (auth)

Radioactive Waste Treatment

Refer also to abstract 23881.

22830 (AAEC/E-364) WASTES AND WASTE MANAGEMENT IN THE URANIUM FUEL CYCLE FOR LIGHT WATER REACTORS. Costello, J. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1975. 55p. Dep. NTIS (US Sales Only) $4.50.

The manufacturing processes in the uranium fuel cycle for light water reactors have been described with particular reference to the chemical and radiological wastes produced and the waste management procedures employed. The problems and possible solutions of ultimate disposal of high activity fission products and transuranium elements from reprocessing of irradiated fuel have been reviewed. Quantities of wastes arising in each stage of the fuel cycle have been summarized. Wastes arising from reactor operation have been described briefly. (auth)

22831 (BNWL-SA-5477) HIGH-LEVEL WASTE CONCENTRATION AND STORAGE: AN OVERVIEW. Burns, R. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 26p. (CONF-751107-16). Dep. NTIS $4.00.

From 68th annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

An overview of high-level waste concentration and storage operations and some of the problems involved in them are given. (LK)

22832 (KFK-2179) RECENT EXPERIMENTS ON FIXATION OF HIGH ACTIVITY WASTES IN KARLSRUHE. Guber, W.; Kahl, L.; Saidl, J. (Kernforschungszentrum Karlsruhe (F.R. Germany). Abt. Behandlung Radioaktiver Abfaelle). May 1975. 23p. Dep. NTIS (US Sales Only) $3.50.

A TiO^-_2 containing glass in which more than 20 wt % of HAW oxides can homogeneously be incorporated, was developed for the solidification of highly active waste solutions from the future large German reprocessing plant. Recently, investigations on the capacity of this glass for further ballast matter as Gd_2O_3, sulphate, chloride, and fluoride became necessary. Results show that besides the 20 wt % of HAW oxides, about 11 wt % Gd_2O_3 can be integrated in the system without substantial deterioration of the final product properties. 1.25% sulphate, 1.1% chloride, and 5.5% fluoride represent maximum amounts when a homogeneous glass product shall be maintained. Moreover, Gd_2O_3 seems even to hinder the separation of the soluble molybdate phase from the glass melt. In addition to the work on borosilicate glass, a similar glass-ceramic composition has been investigated which is described in view of its applicability for the fixation of highly active waste solutions. (auth)

22833 (RT/PROT-(75)20) RADIOPROTECTION PRINCIPLES IN THE DESIGN OF A SYSTEM FOR PROCESSING LIQUID RADIOACTIVE WASTES. Brofferio, C.; De Angelis, F.; Papa, C.; Paribelli, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Oct 1975. 44p. (In Italian). Dep. NTIS (US Sales Only) $4.00.

The main principles of radioprotection are discussed, in view of a sound design of liquid waste processing systems. Critical pathways and doses to workers and people at large are considered also. (auth)

22834 RADIOACTIVE WASTES: PRESENT PROBLEMS AND FUTURE PROSPECTS. Gauvenet, A. (CEA, 75-Paris (France)). Rev. Gen. Nucl.; 1: No. 2, 113-118(Apr 1975). (In French)

The main characteristics of radioactive wastes are described and the present problems arising from liquid or gas effluents are considered. It is concluded that nuclear power stations are considerably less polluting at equal capacity, than conventional power stations. Programs of investigation are now being developed to meet with the foreseeable increase of activity. The problem is: first, to maintain absorbed doses at their present level and second, to study the problem of long-lived elements whose storage would, in the long run, create a nuisance on a world scale. The different waste storage techniques now in use are described and current investigations and works are exposed some of which, like vitrification, have already begun to be put into application. After having noted that the problem of wastes constitutes doubtless a difficulty in the technical field and, maybe even more so in the psychological field, the conditions are defined which will have to be met in order that this problem should not hinder the short- and long-term development of nuclear energy. (FR)

22835 FOAM FLOTATION OF CLAY SORBENTS AS A DEACTIVATION METHOD. Fominykh, V. E.; Pushkarev, V. V.; Pustovalov, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 531-534(1974).

Translated from Radiokhimiya; 16: No. 4, 539-543(1974).

It was established that solutions may be freed from radioactive isotopes (^{91}Y and ^{144}Ce), surface-active substances, and clay particles by foam flotation. The possible reasons for the transfer of the radioactive isotopes from the aqueous solutions into the foam product were examined. The forms of ^{91}Y in aqueous solutions were determined in relation to the pH value. (auth)

Radioisotope Production

Refer also to abstract 22769.

22836 PREPARATION OF CARRIER-FREE RADIOISOTOPES ^{196}Au AND ^{199}Au AND THEIR USE IN ANALYSIS. Gureev, E. S.; Islamov, T.; Lunger, B. A. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 535-537(1974).

Translated from Radiokhimiya; 16: No. 4, 543-545(1974).

A method was developed for the extraction-chromatographic concentration of radioisotopes of gold, and we investigated the possibility of obtaining the radioisotope ^{195}Au carrier-free in a radiochemical pure form from platinum irradiated with accelerated protons in a cyclotron and ^{199}Au from platinum irradiated in a neutron flux in a nuclear reactor. The carrier-free isotopes ^{195,199}Au obtained were used as an internal standard for the quantitative determination of gold in rock with a sensitivity of the order of 10^{-6}%. (auth)

22837 PREPARATION OF CARRIER-FREE BROMINE-77. Iofa, B. Z.; Sevast'yanov, Yu. G. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 555-556(1974).

Translated from Radiokhimiya; 16: No. 4, 562-564(1974).

A method was developed for producing carrier-free ^{77}Br from selenium or arsenic targets irradiated on a cyclotron. The preparations of carrier-free ^{77}Br obtained are always in a radiochemically pure state. (LK)

22838 YTTRIUM-90 GENERATOR. Mikheev, N. B.; Volkova, N. L.; Popovich, V. B. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 644-645(1974).

Translated from Radiokhimiya; 16: No. 5, 653-654(1974).

A ^{90}Y generator based on the cationite Dowex-50 using the complex compound of EDTA and calcium as the eluent was developed. A diagram of the generator is given and its operation and performance discussed. (JSR)

22839 DEVELOPMENT PROGRAM FOR THE PREPARATION OF RADIOACTIVE ISOTOPES FOR MEDICINAL APPLICATIONS BY THE SIN-ACCELERATOR. Hegedues, F.; Chakraborty, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 438-440(Nov 1974). (In German).

The SIN Institute has developed injector and ring-cyclotron techniques for isotope production with energy levels of 80 and 500 MeV. In the first phase iodine-123 production was developed. The production route is outlined, based on capsules of lithium iodide contained in an evacuated chamber, and placed in a target holder. Activity is controlled by means of gamma-spectroscopy of the characteristic radiation of the xenon isotope. Other isotopes to be developed in the future include Rb-81 and K-43, and Pb-203 in ethylenediaminetetraacetate. (INIS)

22840 FORMATION OF CYCLOTRON-ISOTOPES AND THEIR APPLICATION IN NUCLEAR MEDICINE. Huszar, I. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 470-473(Nov 1974). (In German)

Swiss Cyclotron Installations are reviewed and target materials classified as solid, liquid, and gaseous are discussed. Production aspects include the quantity of isotope formation in the target, extraction of primary isotopes and quality control of the end products. Clinical applications outlined are localization studies, electrolytic uses, blood circulation and organic function surveys. A list of nineteen radionuclides is given with half-life times and principal radiation energies in keV. (INIS)

Reactor Fuel Reprocessing

Refer also to abstract 23864.

22841 (CONF-760203-1) RECOVERY OF URANIUM FROM WET PROCESS PHOSPHORIC ACID BY SOLVENT EXTRACTION. Hurst, F. J. (Oak Ridge National Lab., Tenn. (USA)). 1976. 34p. Dep. NTIS $5.00.

From AIME annual meeting; Las Vegas, Nevada, United States of America (USA) (22 Feb 1976).

The OPPA process offers three potential advantages over the DEPA-TOPO process. The OPPA extractant is much less expensive and has a higher extraction power for uranium than the DEPA-TOPO solvent. In addition it extracts U(IV), the prevailing oxidation state of uranium in wet-process phosphoric acid and this eliminates the liquor oxidation step required in the DEPA-TOPO process. However, the DEPA-TOPO solvent is known to be extremely stable and this process has been successfully demonstrated on a pilot-plant scale at phosphate plants. It is understood that several companies are planning to commercialize this process in the near future. On the other hand, the potentially more attractive OPPA process has not been proven in a pilot plant operation and some questions about the solubility and stability of the OPPA need to be answered. Because of the wide spread interest in this process, a program was started in cooperation with Mobil and Allied Chemical companies to study this extractant, to identify and isolate the material that solubilizes the mono- and diacids, and to determine the optimum concentration and ratios for uranium extraction. In addition, a long-term cyclic test is planned to better define solubility losses and stability of the extractant. Consideration will also be given to improving the recovery of uranium lost to the gypsum during calcination. 12 figures. (auth)

22842 (LA-5630-MS(Vol.2)) LASER-ENHANCED CHEMICAL REACTIONS AND THE LIQUID STATE. II. Possible Applications to Nuclear Fuel Reprocessing. DePoorter, G. L.; Rofer-De Poorter, C. K. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 11p. Dep. NTIS $4.50.

Laser photochemistry is surveyed as a possible improvement upon the Purex process for reprocessing spent nuclear fuel. Most of the components of spent nuclear fuel are photochemically active, and lasers can be used to selectively excite individual chemical species. The great variety of chemical species present and the degree of separation that must be achieved present difficulties in reprocessing. Lasers may be able to improve the necessary separations by photochemical reaction or effects on rates and equilibria of reactions. (auth)

22843 (ORNL/TM-5049) ASSESSMENT OF THE RADIOLOGICAL IMPACT OF ^{232}U AND DAUGHTERS IN RECYCLED ^{233}U HTGR FUEL. Till, J. E. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 45p. Dep. NTIS $5.50.

This paper provides an evaluation of the potential radiation exposures to man resulting from the operational releases of ^{232}U and daughters from a hypothetical HTGR fuel reprocessing plant. These estimated exposures are compared to those from the other radionuclides which could comprise the airborne releases from an HTGR fuel reprocessing plant. A hypothetical source term involving both particulate and volatile releases from an HTGR fuel reprocessing plant (450 metric tons of heavy metal annual capacity) is given assuming radionuclide inventories and decontamination factors from the literature. Radionuclides in the source term are ranked according to the magnitude of dose to total body, bone, and lungs for individuals at a distance of 1.5 miles from the stack. Although ^{232}U and daughters account for only 0.1 percent of the total particulate activity, the total-body dose from these radionuclides is greater in magnitude than the dose from all other radionuclides except ^{134}Cs, ^{137}Cs, and ^{90}Sr. Uranium-232 and daughters account for approximately 4 percent of the dose to each organ due to particulates. HTGR uranium fuel and LMFBR plutonium fuel are significantly more radiotoxic (dose commitment to bone) than LWR uranium fuel, and the LMFBR fuel is approximately 500 times more radiotoxic than HTGR fuel for inhalation of equivalent masses of each fuel soon after release to the atmosphere. The dose commitment to bone from HTGR fuel may increase by a factor of approximately 7.5 due to buildup of ^{232}U daughters. (auth)

22844 IMPROVED METHOD FOR THE VERIFICATION OF THE REPROCESSING INPUT ANALYSIS. Koch, L.; Bresesti, M. Nucl. Mater. Manage.; 4: No. 3, 498-507(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Verification of the reprocessing input analysis can be improved by the use of new techniques. Referee samples encapsulated in aluminium cans do not show any storage instability as do solutions. Automatic equipment reduces costs and improves reproducibility. The balancing of pre- and post-irradiation uranium and the isotope correlation technique can not only be used for verification purposes but also enable the detection of sources of error. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

22845 (IPP-Libr-43) QUARTERLY TITLE LIST, JULY–SEPTEMBER 1975. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). 1975. 44p. Dep. NTIS (US Sales Only) $4.00.

A bibliography of reports and publications coming from the laboratory during this period is given. Abstracts are also given. (MOW)

Plasma Confinement and Heating

22846 (AD-731447) VERIFICATION OF A CLASSICAL, SELF-CONSISTENT THEORY OF PARTICLE LOSS IN A HOT ELECTRON MAGNETIC MIRROR COMPRESSION EXPERIMENT. Lieberman, M. A.; Lichtenberg, A. J.; Takeshita, T. (California Univ., Davis (USA). Coll. of Engineering). Jul 1970. Contract AF-AFOSR-1754-69. 20p.

A careful measurement of the particle decay from a hot, electron, magnetic mirror compression experiment (B_0 max $\simeq$ 50 kg, (N_e) max $\simeq 5 \times 10$ the 12th power/cc, k(t_e) $\simeq$ 80 keV) has been performed. The measurement is in good agreement with a classical, self-consistent theory of particle loss, in which a mirror loss cone particle distribution is used. The loss rate predicted from a non self-consistent (Maxwellian distribution of particles) is approximately three times higher than the measured decay rate. The experiment indicated that the more optimistic estimates of fusion feasibility in open-ended systems are correct, and that parameter regimes exist for hot, mirror-confined plasmas in which the losses are given mainly by classical scattering into the loss cone, unenhanced by the presence of instabilities or turbulence. (auth)

22847 (AD-907478) GENERATION OF ENERGETIC ELECTRONS BY ELECTRON CYCLOTRON HEATING IN A MAGNETIC MIRROR FIELD. Hideo, I.; Shuko, A.; Minol, H.; Hiroshi, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1972. 41p. (IPPJ-140).

Electron cyclotron heating that generates hot-electron plasma in a magnetic mirror trap by microwaves is studied experimentally. Evolution of energy distribution functions for the high energy electron is observed in each successive 1 msec during a 200 msec of heating period from the initial stage at the microwave power input until the stationary, final state. According to the proposed statistical model for the cyclotron heating, heating rates are estimated to be 10 MeV/sec typically, under three characteristic cases of the mirror field configuration with the heating microwave power as a parameter. Some problems associated with the stochastic cyclotron heating are discussed in the experimental light. (auth)

22848 (AD/A-000535) MAGNETIC COMPRESSION AND ELECTRON CYCLOTRON HEATING OF A LOW TEMPERATURE, LITHIUM PLASMA. Kim, J.; Lieberman, M. A. (California Univ., Berkeley (USA). Electronics Research Lab.). Mar 1973. Contract AF-AFOSR-1754-69. 10p. Phys. Fluids; 17: No. 3, 559-565(Mar 1974).

Experimental investigation of hot plasmas has often been hindered by the variability and unknown initial conditions of the usual pulsed plasma sources, the difficulty in separating the plasma heating process from the injection process, and the inability to contain heated ions due to charge exchange with background gas. This paper reports magnetic mirror compression and electron cyclotron heating experiments in which a low-temperature lithium plasma produced by contact ionization on a hot plate is used as the initial plasma source. (auth)

22849 (AD/B-002647) PARTICLE LOSS FROM MAGNETIC CUSP FIELD. Namba, C.; Kawamura, T.; Obayashi, H. (Nagoya-Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 16p. (IPPJ-209).

The motion of charged particles in an axially symmetric magnetic field of cusp configuration is studied by means of numerical calculations. A particular attention is paid to a non-adiabatic zone. The computer results are compared with a simplified loss cone model and its is shown that there is a critical value of non-adiabaticity parameter which defines an effective size of the non-adiabatic zone. (auth)

22850 (CONF-751125-116) POWER AND PHASE MONITORING SYSTEM FOR THE LOWER HYBRID PHASED ARRAY HEATING SYSTEM ON ATC MACHINE. Reed, B. W. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 20p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A four waveguide phased array slow wave structure has been constructed to couple microwave energy into plasma in the ATC Tokamac at Princeton. Theory has indicated that the coupling of power into the plasma column is a strong function of the imposed fourier spectrum at the antenna aperture. To optimize heating, and to verify theoretical results, a precision amplitude and phase monitoring system has been designed and constructed. The system data output is routed to an IBM 1800 computer where the fourier spectrum in n parallel space is computed for discrete increments of time during an RF pulse. Computer output data is used to update the adjustment of transmission line parameters inbetween pulses. (auth)

22851 (ERDA-tr-70, pp 33-41) ANOMALOUS ELECTRIC CONDUCTIVITY AND TURBULENT HEATING OF PLASMA IN CLOSED MAGNETIC TRAPS. Dikii, A. G.; Pavlichenko, O. S.; Perepelkin, N. F.; Suprunenko, V. A. 31 Oct 1974. Translated from pp 22-27 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

A phenomenological analysis was made to explain the singularities of the behavior of turbulent current-carrying plasma in a closed magnetic trap and equations were derived describing the conditions for the existence of quasi-steady turbulent heating. Experimental data from the Uragan-I agreed satisfactorily with the theoretical data. (JSR)

22852 (ERDA-tr-70, pp 42-60) CHARGED PARTICLE DIFFUSION DURING OHMIC PLASMIC HEATING IN URAGAN-1 STELLARATOR. Dikii, A. G.; Zalkind, V. M.; Konovalov, V.G. 31 Oct 1974. Translated from pp 28-39 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

Experimental data on the measurement of the lifetime of current plasma in the Uragan-I were analyzed. The basic conclusion drawn from the analysis was that the anomalous diffusion of current plasma is the result of plasma turbulence when the extent of the vacuum magnetic configuration of the stellarator is attenuated by the current flow. (JSR)

22853 (ERDA-tr-70, pp 67-87) INVESTIGATING PLASMA HF HEATING IN URAGAN-1 STELLARATOR. Dikii, A. G.; Kalinichenko, S. S.; Kalmykov, A. A. 31 Oct 1974. Translated from pp 44-56 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

An analysis was made of particle and energy confinement in the stellarator. The results showed that in a wide range of frequency of ion collisions, corresponding to the intermediate region of the neoclassical theory, the energy lifetime of the ions agrees satisfactorily with the results calculated on the basis of the theory. The lifetime of the particles is also in satisfactory agreement with the neoclassical theory, however this conclusion refers to a relatively very narrow range of the intermediate region of the frequency of electron collisions. During the process of plasma heating by high-frequency waves a quasi-steady longitudinal current with a size close to that predicted by theory was detected. This current causes transverse diffusion of the particles in the toroidal magnetic trap. (JSR)

22854 (ERDA-tr-70, pp 88-92) DIFFUSION OF CURRENT DISCHARGE AFTERGLOW PLASMA IN STELLARATOR. Burchenko, P. Ya.; Volkov, E. D.; Lats'ko, E. M.; Rudakov, A. 31 Oct 1974. Translated from pp 57-59 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

It has been hypothesized that the excitation of oscillations in plasma and the increased diffusion were caused by Ohmic heating currents. Experimental studies were made on the Sirius stellarator to measure the basic characteristics of the oscillations and currents induced by these oscillations both in the phase of plasma heating by current and in the phase of discharge afterglow. The experiments were made on a He plasma. The transient development of the plasma density, its electron temperature, luminescence of the He II 4686 A lines, Ohmic heating current, radial distribution of the oscillation frequency of the plasma density at different times after discharge, and lifetime of the plasma after short-circuiting of the Ohmic heating current were

measured. The experimental results of the plasma lifetime were compared with theoretical results. (JSR)

22855 (ERDA-tr-70, pp 101-108) INVESTIGATING PARAMETERS OF PLASMA FORMED DURING ELECTRON-CYCLOTRON RESONANCE IN SATURN STELLARATOR. Berezhnii, V. L.; Voytsenya, V. S.; Voloshko, A. Yu.; Kononenko, V. I.; Solodovchenko, S. I. 31 Oct 1974. Translated from pp 65-69 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

Results are reported on the study of He plasma in the Saturn formed by electron-cyclotron resonance. The results showed that electron-cyclotron resonance can provide a high efficiency for the formation of plasma in the toroidal metallic chamber of the Saturn. The plasma parameters are tabulated. (JSR)

22856 (ERDA-tr-70, pp 120-129) CONFINEMENT OF LOW-DENSITY PLASMA IN VINT-20 1 EQUALS 1 TOROIDAL TORSATRON. HIGH MAGNETIC FIELD INHOMOGENEITY. Voytsenya, V. S.; Voloshko, A. Yu.; Letuchii, A. N.; Manzyuk, N. A.; Pyatov, V.N.; Reva, N. I.; Solodovchenko, S. I.; Suprunenko, V. A.; Sukhommin, E. A.; Tolok, V. T. 31 Oct 1974. Translated from pp 76-81 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

The results obtained on the Vint-20 with large inhomogeneity of the magnetic field, in the region of low collision frequency, were in satisfactory qualitative agreement with the neoclassical theory. The installation is described and the results obtained in the measurement of the parameters and lifetime of the plasma were reported and discussed. (JSR)

22857 (MATT-1175) SUPPRESSION OF HEAVY IMPURITIES IN THE ST TOKAMAK. Meservey, E.; Bretz, N.; Dimock, D.; Hinnov, E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 6p. Dep. NTIS $4.00.

Two different discharges in the ST Tokamak are described: A discharge dominated by high-Z (iron) impurity (Case A), and one dominated by low-Z (oxygen) impurity (Case B). The oxygen-dominated discharge shows higher electron temperature and longer containment time than the iron-dominated discharge. Suppression of Fe and Mo impurities has been achieved by pulsing in air for a few hundred shots. (auth)

22858 (MATT-1185) R.F. HEATING NEAR THE LOWER HYBRID FREQUENCY IN THE FM-1 SPHERATOR. Hawryluk, R. J.; Davis, S. L.; Schmidt, J. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 29p. Dep. NTIS $4.00.

Plasma heating experiments at frequencies near the lower hybrid frequency have been carried out at modest powers (.05 to 4kW). The antenna structure operating at 68 MHz was comprised of two plates driven out of phase on the exterior of the plasma. High electron heating efficiency (greater than 40 percent) in both helium and argon plasmas was observed with only a weak density dependence. At low densities (n/sub e/ less than or equal to 1×10^{11} cm^{-3}), the heating was uniform across the plasma while at higher densities the heating was preferentially on the exterior portion of the plasma. The heating of the exterior of the plasma was found not to correspond to absorption at the lower hybrid resonance layer. The electron heating efficiency was found to be a weak function of rf power when the incident rf power was varied from 1 to 15 times the experimentally observed threshold power for parametric instabilities. Ion temperatures were determined by measuring the Doppler broadening of an Argon ion line using a Fabry-Perot interferometer. Low efficiency main body ion heating (1 to 3 percent) was observed. (auth)

22859 (MATT-1221) QUASILINEAR THEORY OF ION-CYCLOTRON RESONANCE HEATING OF PLASMAS AND ASSOCIATED LONGITUDINAL COOLING. Arunasalam, V. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)-3073. 10p. Dep. NTIS $4.00.

It is shown from quasilinear theory that an initially isotropic magnetized plasma will be forced into an anisotropic state in ion-cyclotron resonance heating. Strong heating of perpendicular ion temperature and strong cooling of longitudinal temperature should occur simultaneously. The maximum temperature ratio predicted by quasilinear theory is in exact agreement with that predicted from basic thermodynamic arguments by Busnardo-Neto, Dawson, Kamimura and Lin. Heating by fast hydromagnetic wave is also examined. (auth)

22860 (MATT-Trans-120) HEATING OF PLASMA IN THE TM-3 TOKAMAK AT THE RESONANCE WITH MAGNETIC FIELDS UP TO 25 kOe. Alikaev, V. V.; Bobrovski, G. A.; Pozniak, V. J.; Razumoa, K. A.; Sannikov, V. V.; Sokolov, Yu. A.; Shmarin, A. A. Feb 1976. Translated by N. Turitzin. 15p. Dep. NTIS $3.50.

Plasma heating experiments were conducted in electron-cyclotron resonance (ECR) with magnetic fields of up to 25 kOe. It was shown, using laser diagnostics that during the electron-cyclotron heating (ECH) the temperature of the main electron component grows in accordance with the classical heating mechanism of ECR. The radial electron temperature distribution was measured. The relationship between the energy confinement time in the tokamak and the electron temperature was obtained, and the magnitude of the energy confinement time of the accelerated electrons as a function of their energy was evaluated. Using ECH, the value beta/sub I/ approximately 2.2 was obtained for low-current discharges. (auth)

22861 (NP-20762) HIGH-FREQUENCY RADIATION FROM STRONG DENSITY FLUCTUATIONS IN A TURBULENT PLASMA. Rutgers, W. R. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Dec 1975. 13p. Dep. NTIS (US Sales Only) $3.50.

The spectrum of electromagnetic radiation emitted by a hot hydrogen plasma yields information on nonthermal fluctuations in a turbulent heating experiment. Its frequency spectrum contains frequencies below the electron plasma frequency f_{pe} during the first half microsecond when plasma turbulence is characterized by streaming instabilities. When after a few microseconds the ion temperature approaches the electron temperature, a current stagnation is observed. Then the spectrum consists of clear maxima at the plasma frequency and its harmonics up to $6\ f_{pe}$. It is demonstrated that radiation can result from strongly anharmonic electron oscillations, which can be as high as $\delta n/n \sim 0.4$, trapped in long-lived solitary density depressions. Above $5\ f_{pe}$ enhanced Bremsstrahlung has to be taken into account. (auth)

22862 (ORNL-tr-4078) RESONANCE MICROWAVE BREAKDOWN IN A TOROIDAL MAGNETIC FIELD. Anisimov, A. I.; Vinogradov, N. I.; Poloskin, B. P. 1975. Translation by S. D. Blalock, Jr. of NP-20329. 7p. Dep. NTIS $3.50.

Some experimental results on microwave breakdown in a toroidal chamber under electron cyclotron resonance conditions are reported. The balance of particles is considered in the single-particle approximation. It is shown that the experimental and calculated data coincide if energy, which electrons gain in resonance regions, is determined by a relativistic change in cyclotron frequency. (auth)

22863 (ORNL-tr-4088) LOSS OF NEUTRALS TO THE WALL DUE TO CHARGE EXCHANGE DURING NEUTRAL BEAM INJECTION INTO A TOROIDAL PLASMA. Putvinskii, C. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation by J. H. Harris of IAE-2520. 19p. Dep. NTIS $3.50.

A theoretical description of the problem is given. The behavior of the injected neutrals is determined by the following elementary processes: resonant charge exchange with the plasma ions, electron impact ionization, and ionization by ion collisions. Some numerical calculations are given. (MOW)

22864 (ORO-4627-2) PENETRATION OF MAGNETIC FIELDS INTO PLASMAS AND HEATING OF A COLLISIONLESS PLASMA BY RADIO FREQUENCY WAVES. Progress Report. Bengston, R. D.; Oakes, M. E. (Texas Univ., Austin (USA). Dept. of Physics). 1975. 8p. Dep. NTIS $3.50.

Experimental work is completed on the effects of neutrals on magnetic piston and sheath development. A preliminary form of this work was presented at the American Physical Society meeting in November, 1975 and is included as appendix. In this work, the measurement and analysis of the current sheath with a data reduction to the microscopic collision frequencies, is also included. The rotation of the plasma during the implosion was detected. Indications are that observations of a nonradial component of the electric field can be related to plasma rotation. (auth)

22865 (UCRL-52000-75-11, pp 1-6) ADVANCED ENERGY SYSTEMS: 2XIIB: HEATING AND CONTAINING MAGNETICALLY CONFINED PLASMAS. Coensgen, F. H. Nov. 1975.

In energy and technology review. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Recent experiments on the 2XIIB mirror machine have produced encouraging results: a buildup of hot ion densities to 4×10^{13} cm^{-3}, ion temperatures of 13 keV (the highest ever observed in a major fusion experiment), and a confinement time exceeding 5 ms. Two major factors in these achievements were the injection of twelve 20-keV neutral beams to increase plasma temperature and the introduction of warm streaming plasma to suppress microinstabilities. With them, near-classical confinement of a hot plasma

was demonstrated. We are now doubling the injected neutral beam energy to see if plasma stability and energy scaling of plasma confinement persist at higher ion temperatures. (auth)

22866 (UCRL-76303) LASER LIGHT ABSORPTION WITH DENSITY PROFILE MODIFICATIONS. Kruer, W.; Valeo, E.; Estabrook, K.; Langdon, B.; Lasinski, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1974. 12p. (CONF-741185-1). Dep. NTIS $3.50.

From seminar on laser interaction with plasma; Fuji, Japan (Nov 1974).

Two-dimensional computer simulations studied plasma heating by electron plasma waves. The results emphasize the importance of nonlinear steepening of the density profile near the critical density. A typical simulation result is presented in order to illustrate these profile modifications. It is shown that large dc magnetic field generation is an inherent property of the absorption of obliquely-incident light. (MOW)

22867 MAGNETICALLY CONFINED PLASMAS USED AS NEUTRON SOURCES. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Nucl. Instrum. Methods; 129: No. 1, 27-30(1 Nov 1975).

It may become possible to create powerful neutron sources from a number of magnetic plasma confinement schemes being investigated in fusion research. Among the one- and two-energy-component plasmas discussed so far, special attention is drawn to quasi-static systems such as the Spherator with magnetically shielded supports, as well as to rotating plasma systems such as the closed Tornado bottle and open bottles. Provided that sufficiently high ion and electron temperatures can be reached, these systems may be operated at higher plasma densities and smaller dimensions than those of mirror and Tokamak neutron sources. (NL)

22868 CONFINEMENT OF HIGH-BETA PLASMA. Bodin, H. A. B. (Culham Lab., Abingdon, Eng.). pp 48-109 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

Three lectures are presented on the basic physics for pulsed thermonuclear reactors based on the high-beta systems. High-beta systems are considered that are nonaxisymmetric and axisymmetric. Stellarators and pinch devices are studied in particular. (MOW)

22869 SOME ASPECTS OF COMPRESSION AND HEATING. Brueckner, K. A. (Univ. of California, San Diego). pp 155-236 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

Three lectures are included on the following: (1) analytic estimates of energy production, (2) shock compression, and (3) problems of implosion physics. The theory is given for the scaling laws involved. (MOW)

22870 SOME REMARKS ON THE POSSIBILITY OF USING HIGH POWER ELECTRON BEAMS FOR THERMONUCLEAR REACTORS. Rudakov, L. I. (Inst. of Atomic Energy, Moscow). pp 237-243 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

Some physical arguments and ideas are briefly discussed that demonstrate the possibility of using electron beams for a pulsed fusion reactor. (MOW)

22871 SOME CONSIDERATIONS OF THE TOROIDAL DIFFUSE PINCH. Carruthers, R. (Culham Lab., Abingdon, Eng.). pp 277-296 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

A number of the basic parameters of a pulsed, magnetically confined, fusion reactor were examined. The advantages of a toroidal diffuse pinch are described. (MOW)

22872 STOCHASTIC HEATING OF ELECTRONS IN ISOTROPIC TURBULENT PLASMA. Komilov, K.; Khakimov, F. Kh. (Tadzhik State Univ., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 18: No. 3, 21-26(1975). (In Russian)

The distribution function of electrons in plasma is derived, taking into consideration the effect of both the high-frequency and the low-frequency oscillations. This equation is quasilinear with respect to high-frequency oscillations. Conclusions can be drawn from the equation on the possible heating of particles of isotropic turbulent plasmas. (JSR)

22873 TRAPPING AND CONFINEMENT OF RELATIVISTIC ELECTRON RINGS IN A STABILIZED MIRROR FIELD WITHOUT CONDUCTING WALL. Luckhardt, S.C.; Woodall, D.M.; Fleischmann, H.H. (Physics Department and Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. Lett. 35: No. 26, 1758-1760 (29 Dec 1975).

Experimental studies indicate that electron rings can be trapped and confined in Astron geometry without a stabilizing conducting wall if a quadrupole-Ioffe or toroidal magnetic field is applied. The ring characteristics are similar to those previously observed in the presence of a conducting wall. All rings trapped with a toroidal field appear to be stably confined. In a Ioffe field, rings with axial self-fields $\delta B \lesssim 0.6B_0$ exhibit a faster-than-usual ring decay. (auth)

22874 ADIABATIC INVARIANCE AND CHARGED-PARTICLE CONFINEMENT IN A GEOMETRIC MIRROR. Samec, T.K.; Lee, Y.C.; Fried, B.D. (University of California, Los Angeles, Los Angeles, California 90024). Phys. Rev. Lett. 35: No. 26, 1763-1766 (29 Dec 1975).

We show that the motion of charged particles, radially confined by slowly converging surface magnetic fields to the interior, $r < R$ (z), of a cylindrical region, has an adiabatic invariant for $(dR/dz) \ll 1$. This provides axial confinement of particles outside of a loss cone, with critical velocity pitch angle given by $\sin^2\theta_c = (R_{min}R_{max})^2$. Computational results verifying the theory are presented and the single-particle lifetime, τ, is found to scale as $|dRdz|^{-5}$ for suitably smooth R (z). (auth)

22875 SELF-TRAPPING OF A LASER BEAM IN A CYLINDRICAL PLASMA COLUMN. Feit, M.D.; Fleck, J.A. Jr. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Appl. Phys. Lett. 28: No. 3, 121-124 (1 Feb 1976).

The laser heating of an initially uniform plasma column has been modeled in a self-consistent way, including the effects of medium magnetohydrodynamics and refraction and diffraction of the laser light. The results show that a portion of the pulse can become trapped, leading to a pattern of alternate focusing and defocusing of the beam. (auth)

22876 ION-CYCLOTRON RESONANCE HEATING OF PLASMAS AND ASSOCIATED LONGITUDINAL COOLING. Busnardo-Neto, J.; Dawson, J.; Kamimura, T.; Lin, A.T. (Physics Department, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 36: No. 1, 28-31 (5 Jan 1976).

We have investigated, via a 1-2/2 dimensional computer simulation, the possibility of forcing an initially isotropic, magnetized plasma into an anisotropic state by means of an external pump. Strong heating of the perpendicular ion temperature was observed together with a strong cooling of the longitudinal temperature. This mechanism could enhance particle trapping in tokamaks and increase confinement time in mirror machines. We use basic physical arguments to predict the maximum temperature ratio that can be obtained. (auth)

22877 ABSORPTION OF LASER LIGHT ON SELF-CONSISTENT PLASMA DENSITY PROFILES. Forslund, D.W.; Kindel, J.M.; Lee, K.; Lindman, E.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). Phys. Rev. Lett. 36: No. 1, 35-38 (5 Jan 1976).

The long-term absorption and scattering of light obliquely incident on an inhomogeneous and self-consistent evolving plasma profile including differential ion flow is considered. In general, the plasma has a sharp rise in density from subcritical to supercritical. The subcritical density decreases for increasing radiation pressure relative to the plasma pressure. In this profile an instability develops of the radiating decay type which modulates and generally enhances the absorption. The plasma density profile appears to evolve toward large light absorption. (auth)

22878 EXCITATION, IONIZATION, AND ELECTRON HEATING IN AN ARGON SHOCK FRONT. Zhikhareva, T.V.; Vasil'ev, M.G.; Morozov, Yu.G. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 3, 354-359 (Mar 1975).

The ionization and excitation of argon atoms and electron heating ahead of a shock front are analyzed. Radiative processes (line and continuum radiation) and collisional processes (electron–atom collisions) are taken into account. The fact that the gas density is higher in the relaxation zone than ahead of the shock front and the reflection of the line and continuum radiation from the tube walls are also taken into account. A system of ordinary differential equations for the densities of the 4^3P_1 and 4^1P_1 states of the argon atoms, the electrons, and the electron temperature are solved numerically to find the profiles ahead of a shock front for pressures in the range p=1–10 torr and Mach numbers in the range M=12–30. The results are compared with experiment. (auth)

22879 ADIABATIC COMPRESSION OF A TOROIDAL PLASMA PINCH BY A MAGNETIC FIELD. Gusev, V.K.; Ipatov, V.A.; Kaganskii, M.G.; Kalmykov, S.G.; Razdobarin, G.T.; Shakhovets,

K.L.; Shprits, N.D. (A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences). JETP Lett. 22: No. 4, 110-111 (20 Aug 1975).

Adiabatic plasma compression was effected in a tokamak-type installation by rapidly increasing the toroidal field. The energy lifetime in the compressed plasma is four times longer than in ohmic heating. The compression is accompanied by an abrupt attenuation of the oscillations in the plasma. (auth)

22880 PLASMA COMPRESSION IN THE TUMAN-2 DEVICE. Berezovskii, E.L.; Gusev, V.K.; Kaganskii, M.G.; Kalmykov, S.G.; Kislyakov, A.I.; Malyshev, G.M.; Pautov, V.L.; Razdobarin, G.T.; Sokolova, L.V.; Tyul'panov, S.S.; Shakhovets, K.G. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 3, 339-345 (Mar 1975).

Experiments on ohmic heating and compression in the Tuman-2 toroidal device are reported. A plasma with a density of $\sim 10^{13}$ cm^{-3} and an electron temperature of 20–30 eV is obtained by ohmic heating in a toroidal field of 3–5 kOe. When this field is raised from 3.2 to 11.5 kOe in 125 μsec effective compression of the plasma is observed: The plasma density increases by a factor of 3 and the electron temperature increases by a factor of 2.5. The heating in compression is shown to be due to improved thermal insulation of the plasma. At the same time, the plasma waves are damped, and the interaction of the plasma with the limiter is weakened. Measurements of the radial density profile show that the transverse diffusion rate decreases in compression. For the compressed plasma the diffusion coefficient is D—$2 \cdot 10^3$ cm^2/sec, which is less than 0.1 of the Bohm diffusion coefficient and in agreement with the diffusion coefficient predicted by pseudoclassical theory. (auth)

Plasma Diagnostics

Refer also to abstracts 22927 and 22950.

22881 (AD-725187) DIAGNOSTICS FOR HOT-ELECTRON, MAGNETICALLY CONFINED PLASMAS. Lichtenberg, A. J.; Schwartz, M. J.; Lieberman, M. A. (California Univ., Berkeley (USA). Electronics Research Lab.). Jun 1970. Contract AF-AFOSR-1754-69. 28p.

Diagnostics have been developed for measuring the temperature, density, velocity distribution, axial and radial profiles, and decay rate of a hot-electron (t_e between 20 and 200 keV) plasma confined in a magnetic mirror field. The diagnostics include the measurement of the magnitude, spectrum, and spatial distribution of the synchrotron radiation, for determining the hot-electron line density, speed distribution, and density profile and angular velocity distribution, respectively, the relative x-ray pulse heights, for determining the speed distribution, the relative spatial distribution of visible light, for determining the density profile, and microwave cavity frequency shifts, for determining the electron number. Comparison among these diagnostics is made. It is shown that measurements of temperature, density, and axial profile can be considerably in error if the experimental results are compared with Maxwellian velocity distributions, rather than self-consistent, mirror distributions. (auth)

22882 (AD/A-005715) ELECTRIC ARCS AND SEEDED PLASMAS. Final Report, 1 September 1970–31 August 1974. Benenson, D. M. (State Univ. of New York, Buffalo (USA)). 27 Dec 1974. 25p. NTIS $3.25.

Experiments and analyses, emphasizing diagnostics (local temperature distributions), have been applied to cross-flow, axial-flow, and seeded plasma configurations. Application of a unique optical system, which permits radiation from the arc to be observed simultaneously at eleven azimuthal angles about the arc column, has permitted the determination of the local temperature distribution for this non-circular (in cross-section) configuration. High speed data acquisition techniques have been applied to determine the local temperatures during the dynamic response of voltage pulsed axial-flow plasmas. The tests carried out upon the cross-flow arc have also detailed the cross-sectional shape and arc profile. (GRA)

22883 (CONF-751125-124) SOFTWARE IMPLEMENTATION OF A HIGH SPEED INTERFACE BETWEEN A PDP-10 AND SEVERAL PDP-11s. De Mesa, N. P. III (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. Contract E(11-1)-3073. 11p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The DMA10 is a high speed link between a PDP-10 and up to eight PDP-11s; specifically, the PDP-10 shares sections of its memory with the PDP-11s. The two segment concept on the PDP-10 of shared/reentrant code and non-shared code is implemented. The inclusion of read only memory on the PDP-11s allows for the development of "PROM" software which all the PDP-11s may share. The principal difference between the DMA10 and other communications interfaces is that it is not a block transfer device. Because of the shared memory concept the features of the DMA10 are high data bandwidth and minimal processor intervention between data transfers. Communication programs between the PDP-10 and the PDP-11 may be tested wholly in either processor, independent of the DMA10 interface. In the current mode of operation the PDP-11's simply act as device controllers. Future plans include separate operating systems in various PDP-11s. (auth)

22884 (EUR-CEA-FC-781) RESOLUTION OF A WIEN FILTER WITH LARGE ENTRANCE SLIT. Theiss, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). Aug 1975. 25p. (In French). Dep. NTIS (US Sales Only) $3.50.

A simple formula is derived for the resolution of Wien filter. The formula, which takes into consideration the opening of the entrance slit and the brightness of the entering beam, can be easily applied. The formula has been compared with the measured resolution of a Wien filter. (auth)

22885 (SAND-76-6012) SPECTROSCOPIC STUDY OF AN ARGON PLASMAJET OUT OF LOCAL THERMODYNAMIC EQUILIBRIUM. Ranson, P.; Chapelle, J. Translated by D. P. Aeschliman from J. Quant. Spectrosc. Radiat. Transfer; 14: No. 1, 1-18(Jan 1974). 26p. Dep. NTIS $4.00.

The properties of an argon plasmajet seeded with a few percent of hydrogen were studied. At atmospheric pressure, significant deviations from local thermodynamic equilibrium (LTE) are shown. The plasma parameters (electron density N/sub e/, temperature T) have been determined from the broadening and the absolute intensity of hydrogen lines. The transition probabilities and the broadening parameters (width and shift) of some AI lines between 4000 and 6000 A have been measured. (auth)

22886 MASS SPECTROMETRIC STUDY OF THE DISCHARGE CATALYZED REACTION $2CO(g) \rightarrow C(s) + CO_2(g)$. Haque, M.R.; Oswald, H. R.; Veprek, S. (Zurich Univ. (Switzerland)). pp 42 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The reverse reaction $2CO \rightarrow CO_2 + C$, which is kinetically hindered without the plasma, can be catalyzed by a weak discharge. By a comparison of the time constants of different possible elementary reactions, evaluated from the known relevant experimental data, and the observed behavior of steady-state concentrations of the dominant species in the discharge as a function of their residence time in the active discharge, it is shown that ion-molecule reactions are dominant in the reverse reaction. (NL)

22887 INVESTIGATION OF THE ENERGY DISTRIBUTION OF POSITIVE IONS IN A LOW TEMPERATURE PLASMA. Borodin, N. A.; Dudko, D. Ya.; Korchevoy, Yu. P.; Makarchuk, V. N. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrodinamiki). pp 35 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The energy distribution of atomic K^+ and molecular K_2^+ ions has been investigated experimentally in the plasma of the positive column of a discharge in potassium vapor ($10^{-3} < p_K < 5.10^{-2}$ mm. Hg) under stationary conditions. The temperature of the ions $K^+ T_{11}$ and $K_2^+ T_{12}$ has been determined. (NL)

22888 SECONDARY ELECTRON ENERGY DISTRIBUTION IN A FAST-BEAM CREATED NITROGEN PLASMA. Edgley, P. D.; Rockett, P.; Brundin, C. L.; von Engel, A. (Oxford Univ. (UK). Dept. of Engineering Science). pp 40 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The energy distribution of secondary electrons in the plasma created by a fast electron beam in nitrogen has been determined using an electrostatic probe. Measurements have been made in both stagnant gas and in a supersonic flow, in a low-density facility used for aerodynamic studies. (NL)

22889 APPROXIMATION OF THE OPTICALLY THIN LAYER IN PLASMA SPECTROSCOPY. Preobrazhenskii, N. G. (Institute for Pure and Applied Mechanics, Siberian Division, Academy of Sciences, Novosibirsk, USSR). pp 29 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Recent studies are described of criteria for the optically thin approximation relevant to more reliable interpretation of various plasma spectroscopic measurements. Nonequilibrium situations are in the focus of attention. Applicability of well-known criteria suggested by McWhirter and Hearn is outlined. (NL)

22890 ESCAPE FACTOR FOR FREQUENCY DEPENDENT SOURCE FUNCTION. Kuszell, A.; Preobrazenski, N. G.; Suckewer, S. (Institute of Nuclear Physics, Krakow (Poland)). pp 26 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

In plasma spectroscopy asymmetric reabsorbed line profiles are frequently observed; a possible explanation of this asymmetry is the difference between the absorption contour and spontaneous emission which leads to a frequency dependence of the source function. (NL)

22891 UNIFIED ELECTRON TEMPERATURE CHARACTERISTICS IN Ne AND He POSITIVE COLUMNS. Dote, T.; Ichikawa, Y. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). pp 51 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The cylindrical positive column theory was renewed by using the boundary velocity of charged particles defined by Friedman, et al. This theory is extended to cases of not neglecting the Frost effect which means that a radially variable positive ion mobility is included in the positive column theory, the effect of metastable atoms ionization and furthermore binary-mixtured gas. The electron temperature characteristics based upon this theory were calculated for Ne and He gases. These results may be useful for an investigation of the He-Ne laser plasmas. (NL)

22892 BALMER RADIATION FROM MAGNETIZED HYDROGEN PLASMA AND ELECTRON DENSITY ESTIMATES FROM COLLISIONAL-RADIATIVE MODEL. Hui, A. K.; Ghosh, P. K. (Indian Inst. of Tech., Kanpur. Dept. of Chemistry). pp 54 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Emission of H_α, H_β and H_γ Balmer radiation has been measured in hydrogen plasma in presence of an axially symmetric magnetic field. An attempt has been made to correlate the emission enhancements with plasma electron density using the collisional radiative model of Bates, Kingston, and McWhirter. (NL)

22893 MASS-SPECTROMETRIC STUDY OF IONIC COMPOSITION IN POTASSIUM–NITROGEN DISCHARGE PLASMA. Morgulis, N. D.; Przonsky, A. M. (Kievskij Gosudarstvennyj Univ. (Ukrainian SSR)). pp 46 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The ionic composition has been studied in a two-component discharge plasma produced in the mixture of potassium vapors at pressure ranging from 10^{-16} to 10^{-2} mm Hg, and of pure molecular nitrogen at pressure of 0-1 mm Hg. (NL)

22894 ATOMIC LEVEL POPULATION DENSITIES IN DECAYING OVERCOOLED HELIUM PLASMAS. Filippov, S. S.; Yevstigneyev, V. V. (AN SSSR, Moscow). pp 41 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Qualitative features of helium atomic level population in plasmas far from equilibrium are discussed. The excited level population densities of helium atoms are calculated in "stationary flow" approximation for electron temperatures 0.1-0.4 eV and electron densities 10^{14}-10^{16} cm^{-3}, assuming the ionization degree more than 0.001. The conditions of inverse population are investigated both for pure helium plasmas and for mixtures of helium with other gases. (NL)

22895 BOUNDARY LAYER BETWEEN A ROTATING PLASMA AND A NEUTRAL GAS BLANKET. Hellsten, T.; Raggi, R. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Nucl. Instrum. Methods; 129: No. 1, 11-18(1 Nov 1975).

The boundary layer situated between a rotating hydrogen plasma of high density and a surrounding neutral gas blanket has been investigated by means of electric probes. The measured parameters are the electric field, the plasma density, and the electron temperature. The surface generated by the magnetic field lines touching the cathode plate acts as a strong plasma sink. Outside this surface a dilute plasma has been detected. The behavior of the partially ionized region and its boundaries is in agreement with theoretical deductions. (NL)

22896 METHOD FOR MEASURING THE HEAVY STRIPPED ION ABUNDANCES OF PLASMA. Briand, P.; Geller, R.; Theiss, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). Nucl. Instrum. Methods; 129: No. 1, 19-26(1 Nov 1975).

A description is given of a system which uses a velocity filter and an energy filter in tandem to analyze the abundances and energy spreads of highly stripped ions. The system can also serve as a plasma diagnostic tool. (NL)

22897 MEASUREMENT OF NEUTRON FLUX FROM A TOKAMAK PLASMA DEVICE. Morgan, G. L.; England, A. C. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Instrum. Methods; 129: No. 1, 1-9(1 Nov 1975).

A system has been developed for neutron flux measurements at the ORMAK tokamak device. This system allows measurement of the time-dependence of the neutron flux during a single shot of the device as well as the energy spectrum of the neutrons. Pulse shape discrimination techniques are used with a liquid scintillation counter (NE 213) to eliminate events in the detector due to gamma rays and X-rays generated in the plasma. Results are presented for the mode in which neutral deuterium is injected into a deuterium plasma. (NL)

22898 LASER SCATTERING MEASUREMENTS ON A DEUTERIUM PLASMA IN THE ROTATING MAGNETIC FIELD PINCH. Pietrzyk, Z. A.; Hofmann, F.; Lietti, A. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Z. Angew. Math. Phys.; 25: No. 6, 717-725(25 Nov 1974).

Electron temperature and density were measured in the rotating magnetic field pinch by means of laser light scattering. The results are compared with previous measurements and with numerical calculations based on a three-fluid magnetohydrodynamic model. The comparison between theory and experiment shows that the interior surface of the discharge tube acts as a plasma source producing approximately $0.6 * 10^{15}$ electron-ion pairs per cm^2 per μs. (auth)

22899 COMPACT TELEMETER FOR PLASMA LOSSES ON ISOLATED SURFACES. Nonn, P.D. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Rev. Sci. Instrum. 47: No. 2, 228-231 (Feb 1976).

Two infrared light-beam telemeters for reading currents between 1×10^{-6} and 5×10^{-4} A at frequencies from dc to 100 kHz are described. One design is currently in use aboard the isolated rings of the Wisconsin levitated octupole for measuring the flux of plasma to collectors on the ring surface from the stable confinement region around the ring. This device is triggered from outside the vacuum vessel and applies a 20 V bias to the striped plasma collectors. Each telemeter is completely contained within a 1 cm diam by 12 cm long case and, although buried in the solid aluminum rings, can be removed and serviced through airlocks. A second telemeter design, a more versatile but much more complex predecessor, is powered by capacitors that are charged by a bank of solar cells, which are illuminated by a light source outside the plasma containment zone in controlled patterns to select bias from 0 to 50 V in 10 steps. Elaborate precautions were taken to avoid anticipated possible interference from plasma light, large magnetic fields, and high microwave fields. (auth)

22900 ELECTROSTATIC ENERGY ANALYZER USING A NONUNIFORM AXIAL MAGNETIC FIELD. Hsu, T.; Hirshfield, J.L. (Department of Engineering and Applied Science, Yale University, New Haven, Connecticut 06520). Rev. Sci. Instrum. 47: No. 2, 236-238 (Feb 1976).

Electrostatic electron energy analysis in a strong magnetic field using conventional retarding-field methods may be inaccurate, because these devices discriminate against parallel momentum and not total energy. We show how a magnetic-field minimum at the point of minimum potential can remove this difficulty. Examples of elastic and inelastic electron-atom scattering, and of electron energy loss in a plasma, are given. (auth)

22901 POSSIBILITY OF OBSERVING CORONAL SPECTRAL LINES IN A LABORATORY PLASMA. Shcheglov, D.A. (I. V. Kurchatov Institute of Atomic Energy). JETP Lett. 22: No. 4, 114-115 (20 Aug 1975).

The factors that determine the possibility of registration, under laboratory conditions, of forbidden lines observable in the spectrum of the solar corona are discussed. Certain results of spectroscopic measurements in the "Tokamak-4" installations are interpreted as observation of the "green line" of the ion Fe XIV. (auth)

22902 NEUTRAL-BEAM MEASUREMENT OF THE WELL DEPTH IN AN ELECTROMAGNETIC TRAP BY A NEUTRAL-PARTICLE BEAM. Vdovin, S.A.; Kalmykov, A.A.; Naboka, V.A.; Pankrat'ev, Yu.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 3, 351-353 (Mar 1975).

A system for measuring the depth of a potential well by means of a particle beam is described. In this method the plasma is probed by a beam of neutral hydrogen or argon atoms at energies 5–15 keV. The well depth is inferred from the time dependence of the energy spectrum of the ions produced in the ionization of neutrals in the potential well. Two methods for measuring the time dependence of the potential are proposed. (auth)

22903 SUBMILLIMETER PLASMA POLARIMETRY IN A TRANSVERSE MAGNETIC FIELD. Berezhnaya, V.P.; Petrov, G.D.; Petryakov, A.I. (All-Union Scientific-Research Institute of Physicotechnical and Radiotechnical Measurements). High Temp. 13: No. 3, 628-630 (May 1975).

The electron density of a plasma situated in a transverse magnetic field is determined by studying the polarization of electromagnetic waves propagating through the plasma. (AIP)

Plasma Kinetics (General)

22904 (AD-745016) GAS-EMBEDDED Z-PINCH AND NUMERICAL SIMULATION OF HIGH DENSITY PLASMA DEVICES. Tidman, D. A. (Versar, Inc., Springfield, Va. (USA)). Jun 1972. Contract N00014-71-C-0082. 45p.

The first six sections of the report summarize work on the gas-embedded z-pinch. Section 7 contains a description of work in progress to develop a numerical simulation of the lithium "liner" for the collapsing theta-pinch experiment (and other devices). (auth)

22905 (AD-748179) NUMERICAL STUDY OF THE GAS-ENCLOSED Z-PINCH. Anderson, D. V.; Lampe, M.; Manheimer, W. (Naval Research Lab., Washington, D. C. (USA)). Aug 1972. 21p. (NRL-MR-2486).

A one-dimensional radial fluid code was developed to study the time development and energetics of a z-pinch embedded in a dense background hydrogen gas. The code uses a flux-corrected Lax-Weindroff algorithm to solve the one-fluid MHD equations together with the external circuit equations in a self-consistent energy-conserving way. Fractional ionization is determined by the Saha equation. Classical thermal and electrical conductivity are included at present, but anomalous transport can easily be inserted if required. Bremsstrahlung emission and absorption are included. MHD instabilities are not included, but are studied analytically in a separate report. Preliminary results indicate that current rise-times at least one order of magnitude faster than the present pharos circuit (about 100 micro sec) are highly desirable, and that fusion temperatures do seem possible with these faster circuits. (auth)

22906 (AD-748717) THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A SHOCK-TUBE DRIVEN JXB ACCELERATOR. McComber, P. L. P.; Moffatt, W. C. (Royal Military Coll. of Canada, Kingston, Ontario). 1971. 11p.

The paper presents the results of an analytical and experimental investigation of a one-dimensional, continuous-electrode, shock-tube driven MHD accelerator. The unsteady flow behind an ionizing shock wave in argon subjected to transverse electric and magnetic fields is analyzed using the method of characteristics. The magnetic Reynolds number is assumed much less than unity, the gas is assumed to be in local thermodynamic equilibrium, and Hall effects are included. The results for a typical calculation are presented. (auth)

22907 (AD-770851) ENERGY INPUT INTO A GAS ENCLOSED Z-PINCH. Manheimer, W. M. (Naval Research Lab., Washington, D. C. (USA)). Oct 1973. 21p. (NRL-MR-2619).

In a gas-enclosed Z-pinch experiment, energy is coupled from an external circuit by rapid buildup of a confining field. From the basic energetics, one can calculate the necessary current rise times from maintenance of equilibrium as a thermonuclear pinch is being formed. If the rise time is too slow, the Ohmic heating of the plasma will be fast compared with the buildup of the confining field, and it will blow out; if too fast, the confining field will build up before the plasma can heat appreciably. In the early phase of heating, very short rise times are needed (nanoseconds) so that the initial tendency of the plasma is to blow outward. (auth)

22908 (ERDA-tr-70) PLASMA PHYSICS AND PROBLEMS OF CONTROLLED THERMONUCLEAR FUSION. Tolok, V. T. (ed.). (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 31 Oct 1974. Translation of KHFTI-74-36. 149p. Dep. NTIS $5.45.

Separate abstracts were prepared for the 12 included papers. (MOW)

For abstracts of individual papers see: 22851–22856, 22909, 22910, 22925, 22956, 22991, and 22992.

22909 (ERDA-tr-70, pp 61-66) CURRENT-CARRYING PLASMA NOISE AND EPITHERMAL UHF RADIATION IN ELECTRON RUNAWAY MODE. Vasil'ev, M. P.; Dikii, A. G.; Kulaga, A. E.; Litvinov, A. P.; Perepelkin, N. F.; Suprunenko, V. A. 31 Oct 1974. Translated from pp 40-43 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

An analysis of the turbulent noise spectrum of the current-carrying plasma in the stellarator confirmed the previously published assumption on the decay in the non-isothermal plasma of shortwave suprathermal ion-noise oscillation. From the wide oscillation spectra observed in the "Uragan" stellarator of low-frequency plasma oscillations with a characteristic frequency of 1 kHz there is probably a direct relationship to the mechanism for the electron acceleration in the period of current flow. (JSR)

22910 (ERDA-tr-70, pp 93-100) TURBULENT NOISE OF CURRENT-CARRYING PLASMA IN STELLARATOR. Barkov, A. P.; Burchenko, P. Ya.; Volkov, E. D.; Kutsyn, A. A.; Maznichenko, M. E.; Pavlichenko, O. S.; Rubtsov, K. S. 31 Oct 1974. Translated from pp 60-64 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

Experiments were made on the Sirius stellarator to measure the intensity of the microfields in the plasma and to determine the level of the turbulent noise in order to evaluate the ratio of the energy of the microfields to the thermal energy of the plasma. Radiation was observed in the region of the forbidden He I line at 4920.35 A. The size of the microfield intensity in the plasma was in the limits 0.9 kV/cm less than or equal to tilde E less than or equal to 2.5 kV/cm. The level of the turbulent noise varied within the limits 3×10^{-4} less than or equal to W/pi T less than or equal to 2.5×10^{-3}. The effective collision frequency was nu/sub eff/ approximately omega/sub pe/(W/pi T) x (omega/sub pe//omega/sub Hc/). (JSR)

22911 (MATT-1186) COMPARISON OF THE D-T NEUTRON WALL LOAD DISTRIBUTIONS IN SEVERAL TOKAMAK FUSION REACTOR DESIGNS. Chapin, D. L.; Price, W. G. Jr. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 49p. Dep. NTIS $4.00.

The distributions of the neutron angular and scalar flux and current around the wall of three proposed tokamak fusion reactor designs are investigated in detail. The calculational method involves a numerical solution of the integral form of the neutron transport equation using a ray tracing process. The wall loading in a circular cross section tokamak and in two non-circular tokamaks, the Princeton Reference Design and the University of Wisconsin UWMAK, are compared for three different plasma source distributions. The variation of the angular neutron flux at different wall points is investigated for each design. Neutron wall load peaking factors are also calculated and compared for each design, and are found to be sensitive to both the wall shape and plasma source. The divertors in the two non-circular designs are studied for neutron streaming losses and for the wall load in those regions. (auth)

22912 (TRITA-EPP-75-11) CURRENT CHOPPING SPACE CHARGE LAYERS IN A LOW PRESSURE ARC PLASMA. Torven, S.; Babic, M. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Apr 1975. 6p. (CONF-750877-1). Dep. NTIS (US Sales Only) $3.50.

From 12th international conference on phenomena in ionized gases; Eindhoven, Union of Soviet Socialist Republics (USSR) (Aug 1975).

Chopping of the electric discharge current occurs in the positive column of low pressure mercury arcs, accompanied by a rapid increase of the tube resistance. The high tube voltage drops occurring when the current is stabilized by the external circuit are found to be concentrated to a single space charge layer, which forms across the column. Simultaneously, microwave emission and fast electrons can be detected. For currents close to the in-

stability threshold, small amplitude voltage pulses are found to propagate along the column with the ion sound speed. (auth)

22913 EXPERIMENTAL STUDY OF SIMILARITY CONDITIONS FOR ELECTRON-ENERGY DISTRIBUTION FUNCTION IN HELIUM–CESIUM PLASMA. Asvadurov, K. D.; Vasilieva, I. A. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). pp 49 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The similarity parameters determining the change in the electron distribution function $f\epsilon$ in a positive column of a helium-cesium discharge are investigated. (NL)

22914 INFLUENCE OF ATOMIC TO MOLECULAR ION CONVERSION ON THE RADIAL CHARGE DISTRIBUTION IN THE POSITIVE COLUMN. Musa, G.; Popescu, A. (Academia R.S.R., Bucharest (Romania). Institutul de Fizica). pp 62 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

In the present paper, the influence of the atomic to molecular ions conversion on the radial charge distribution has been considered. Atomic to molecular ions conversion is possible as the result of the triple collisional reaction $X^+ + X + X$ reversible $X_2^+ + X$ with subsequent change of the mobility of the charged particles. (NL)

22915 NATURE OF THE STATIONARY PROCESSES IN PENNING TYPE HIGH VOLTAGE DISCHARGE. Kervalishvili, N. A.; Kortkhonjia, V. P. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). pp 56 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Mechanism of electron transport across the magnetic field in the low-pressure high-voltage discharge has not been studied fully so far. This paper deals with the results of the discharge current calculations with the account of the ion volume charge and surface phenomena caused by the inverse bombardment of the cathode with the anomalously high energy electrons. The comparison of the theoretical dependencies with the experimental results is given. (NL)

22916 ION MOTION EFFECT IN STARK PROFILES OF HYDROGEN LINES IN A PLASMA. Demura, A. V.; Lisitsa, V.S.; Sholin, G. V. (I. V. Kurchatov Institute of Atomic Energy, Moscow, USSR). pp 37 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

For a long time in the problem of Stark broadening of spectral lines in a plasma there were systematic discrepancies between calculated and experimentally observed values of the dip in the center of hydrogen lines H_β and H_δ. Only recently Wiese and Kelleher managed to show that values of this dip were sensitive not only to the density of charged particles N but to the mass of perturbing ions also. On these grounds it was suggested that the ion motion should play an important role in the formation of the central part of the Stark profile. In the present paper the theory explaining qualitative relations observed at the experiment is proposed. (NL)

22917 DYNAMICS OF IONIZATION AND RADIATION OF IMPURITY IONS IN PLASMA. Dnestrovskii, Y. N. (I. V. Kurchatov Institute of Atomic Energy, Moscow, USSR); Inovenkov, I. N.; Kostomarov, D. P.; Strizhov, V. F. (Moskovskij Gosudarstvennyj Univ. (USSR)). pp 38 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The distribution of impurity ions among ionization stages is of considerable interest for the physics of ionized gases. This distribution determines radiative losses and the average effective charge of plasma. In this paper the authors investigate dynamics of ionization and compute intensities of radiation for different models of impurity sources for ions of C, O, Fe, Mo and W. (NL)

22918 PULSED FUSION REACTORS. Conference Held at Erice-Trapani, Sicily, Italy, September 9–20, 1974. New York; Pergamon Press (1975). 775p. (EUR-5307e; CONF-7409131-).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974).

Separate abstracts were prepared for 23 of the included papers. Abstracts for 4 of the papers are included in ERDA Research Abstracts. Abstracts for all 23 papers appear in NSA. (MOW)

For abstracts of individual papers see: 22868–22871, 22919, and 23017–23034.

22919 ENERGY FROM THERMONUCLEAR FUSION: BASIC PHYSICAL PARAMETERS. Linhart, J. G. (EURATOM–CNEN, Frascati, Italy). pp 28–47 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The following topics are described: (1) astrophysical prelude, (2) explosive fusion, (3) the trigger-criterion, (4) magnetic confinement, (5) high magnetic field confinement, (6) microexplosions, and (7) economics. (MOW)

22920 STRUCTURE OF THE BOUNDARY LAYER BETWEEN A FIELD-FREE PLASMA AND A MAGNETIC FIELD IN VACUUM. Gruber, R.; Weibel, E. S. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Z. Angew. Math. Phys.; 25: No. 6, 701-715 (25 Nov 1974). (In German).

Self-consistent solutions of Vlasov's equations describing a plane boundary layer without shear are given. The currents within the layer are due to free and trapped electrons. The ion current is neglected since $m_e \ll m_i$. The free electrons and the ions are assumed Maxwellian at infinity. For the trapped electrons a one parameter family of distribution functions is assumed. Profiles are computed for potentials, fields, densities and currents for different numbers of trapped electrons. Numerical solutions are obtained by applying the method of finite elements to a variational formulation of the problem. (auth)

22921 DENSITY, COLLISION FREQUENCY, AND ENERGY DISTRIBUTION OF ELECTRONS IN THE POSITIVE COLUMN OF A NITROGEN GLOW DISCHARGE. Ivanov, Yu.A.; Karabashev, I.N.; Ovsyannikov, A.A.; Polak, L.S.; Slovetskii, D.I. (Institute of Petrochemical Synthesis, Academy of Sciences of the USSR). High Temp. 13: No. 3, 433-438 (May 1975).

An analysis is made of systematic errors in the measurement of electron density by microwave-cavity and Langmuir probe methods, and of the electron energy distribution function by the Langmuir probe method. The electron density and energy distribution are obtained by the probe method for pressures of 0.65 to 3.9 mm Hg and currents of 30 to 75 mA. At pressures from 0.65 to 5 mm Hg and currents from 5 to 100 mA the microwave method is used to obtain the electron density and collision frequency. The measured distribution functions are used to obtain the electron transport coefficients and the ionization frequency of molecular nitrogen in the positive column. The microwave and probe data are in good agreement with each other. (auth)

22922 THERMAL AND GASDYNAMIC CHARACTERISTICS OF AN ARGON INDUCTION DISCHARGE. Klubnikin, V.S. (M. I. Kalinin Leningrad Polytechnic Institute). High Temp. 13: No. 3, 439-446 (May 1975).

Thermal (electron and heavy-particle temperatures, input power, and power removed by a plasma jet through the end of the heater) and gasdynamic (total, dynamic, and static pressures) characteristics are investigated for an induction discharge in water-cooled quartz heaters, 3 and 4 cm in diameter. Different methods were used for the measurements. It is shown that thermal nonequilibrium occurs only at the entrance and outer regions of the discharge. The characteristics of discharges in quartz heaters are compared to those in slotted metal heaters. The latter have a low efficiency. Measurements of the static and total pressure distributions indicate that a recirculation flow is present at the entrance of the plasmon and that in some cases the surrounding air is sucked into the discharge through the exit slit of the heater. It is shown that present models of the discharge need to be improved. (auth)

22923 CALCULATING THE PARAMETERS OF THE POSITIVE COLUMN OF A DISCHARGE IN A STREAM OF HELIUM. Gol'dfarb, V.M.; Lyagushchenko, R.I.; Tendler, M.B. (A.I. Gertsen Leningrad State Pedagogical Institute). High Temp. 13: No. 3, 460-464 (May 1975).

The equations for the electron balance and the electron-energy balance are used in conjunction with the expressions for the discharge current to calculate the "internal" positive-column parameters (electron temperature, electric field strength, absolute electron concentrations, distribution of electron concentration along the stream) of a discharge in a stream of helium having gas pressure $p \sim 100$ mm Hg, flow velocity $v \simeq 10^4$ cm/sec, and gas temperature $T_g = 300$°K. A formula connecting the ionization frequency with the flow velocity and the coefficient of ambipolar diffusion is obtained. The deviation of the distribution from the Maxwell and Druyvesteyn functions is taken into account, as is the

step-by-step nature of ionization. The T_e and n_e relaxation outside the discharge region is considered. The degree of gas heating in the discharge region and the role of electron heat conduction in the electron energy balance are evaluated. (auth)

22924 BREAKDOWN OF THE GAS AHEAD OF A SHOCK FRONT IN AN INDUCED ELECTRIC FIELD. Maksimov, A.A.; Ostashev, V.E. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 13: No. 3, 581-583 (May 1975).

Using a two-state explosive shock tube, we have investigated the effects of the radiation propagating ahead of the shock front. (AIP)

Plasma Kinetics (Experimental)

22925 (ERDA-tr-70, pp 23-32) ELECTRON THERMAL CONDUCTIVITY OF CURRENT-CARRYING PLASMA IN STELLARATOR. Wuersching, E. (Max-Planck Inst., Garching, W. Ger.); Pacher, H.; Renner, H.; Ringler, H.; Hacker, H.; Dikii, A. G.; Pavlichenko, O. S.; Supruenenko, V. A.; Tonkopryad, V.M. 31 Oct 1974. Translated from pp 16-21 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

Experimental data obtained on the Uragan-I and Wendelstein II B stellarators were analyzed together in an attempt to explain the character of the dependence of the electron temperature of the current-carrying plasma on the size of the poloidal magnetic field. The use of data from both installations made possible simulations both with respect to the large radius of the torus and with respect to the angle of rotational transformation for stellarators with quite different configurations of the magnetic field. The analysis showed that the pseudoclassical formula of Artsimovich satisfactorily describes the electron temperature of the current-carrying plasma. (JSR)

22926 EXPERIMENTAL STUDY OF METASTABLE ATOM FLUX TO THE TUBE WALL IN AN ARGON POSITIVE COLUMN OF GLOW DISCHARGE. Martisovits, V.; Kosinar, I.; Tarabek, P.; Veis, S. (Dept. of Experimental Physics, Komensky-University, Bratislava, Czechoslovakia). pp 59 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The effusion method has been used for measuring the metastable atom flux to the wall in the argon positive column over the pressure range 0.1-3 torr and discharge current from 5 to 40 mA in a discharge tube of radius 3.5 mm. The metastable atoms were detected by the time-of-flight technique using a gated collector. Observed variation of the flux as a function of the pressure was compared with a theory assuming the loss of metastable atoms due to diffusion and collisions with electrons and ground state atoms. (NL)

22927 MASS COMPOSITION OF POSITIVE AND NEGATIVE IONS IN ALKALI PLASMA. Dudko, D. Ya.; Korchevoy, Yu. P.; Makarchuk, V. N. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrodinamiki). pp 39 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The mass composition of positive and negative ions generated in potassium plasma has been investigated experimentally by a mass-spectrometer method. It is shown that in nonequilibrium alkali plasma together with atomic ions X^+, the formation of stable molecular ions X_2^+, X_3^+, X_4^+, X_5^+, X_6^+, X_7^+, and negative ions X^-, X_2^-, X_3^-, is possible. (NL)

22928 RADIATION FROM PLASMA FOCUS IN THE RANGE OF 1-40 eV. Zvorykin, V. D.; Klementov, A. D.; Rozanov, V. B. (AN SSSR, Moscow. Fizicheskij Inst.); Kamrukov, A. S.; Kashnikov, G. N.; Kozlov, N. P.; Malascenko, V. A.; Protasov, Yu. S. (Moscow Higher Technical School, USSR). pp 32 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The studies of dense radiating plasma ($N_e = 10^{17}$-10^{19}, $T_e = 2$ to 10 eV) include the problem of radiation distribution over the quantum energy which is of great interest. A considerable fraction of this radiation is emitted in the vacuum-ultraviolet region, and may be caused by recombination of electrons to the ground state of double-, triple- and higher-charged ions. In the case of optically thin plasma, the recombination maxima may be revealed in the spectrum; and if the intensity of recombination radiation is considerable, this type of plasma can be used as an effective source of radiation in the far-ultraviolet range. (NL)

22929 NEGATIVE IONS IN A CO_2-N_2-He MIXTURE PLASMA. Bacal, M.; Doucet, H. J. (Ecole Polytechnique, 75-Paris (France). Lab. de Physique des Milieux Ionises). pp 34 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The negative and positive ion spectra of a diffusion-type plasma produced at approximately 1μ in a CO_2-N_2-He mixture have been measured. The major negative ion observed in this plasma is the cyanate ion (NCO^-) or its isomer. (NL)

22930 CONTRIBUTION OF VIBRATIONAL EXCITATION TO THE RATE OF CO_2 DISSOCIATION IN RADIOFREQUENCY DISCHARGES AT MODERATE PRESSURES. Capezzuto, P.; Cramarossa, F.; d'Agostino, R.; Molinari, E. (Bari Univ. (Italy)). pp 36 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Non-Maxwellian electron energy distribution functions and experimental results on CO_2 dissociation in electrical discharges are used to show that a mechanism of dissociation involving vibrationally excited molecules can make a significant contribution to the observed rates and becomes the dominant one at pressures above and about 20 torr. (NL)

22931 STEADY STATE CHARACTERISTICS OF A LARGE VOLUME COLLISIONAL PLASMA CONTAINED BY PERMANENT MAGNETS. Jones, H. G.; Lauer, G. (Loughborough Univ. of Technology (UK). Dept. of Physics). pp 55 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J.G.A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The dc characteristics of a nitrogen plasma produced in a vessel of about 25-litre capacity are outlined. A single thermionic cathode and separate anode were used. A plasma density of approximately 10^{11} cm^{-3} was produced at background pressures of up to 200 m torr. (NL)

22932 PLASMA STRATIFICATION IN THE ANODE AREA OF THE GLOW DISCHARGE IN A GAS FLOW. Kopyrina, R. I.; Mylnikov, G. D.; Vedenov, A. A. (Kurtchatov Institute of Atomic Energy, Moscow, USSR). pp 58 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

A glow discharge at low pressure ($\leq$1 torr) is investigated rather well, nevertheless discharge properties in a gas flow at pressures 10-100 torr and higher are poorly known. Moreover, there exist various constructive ways to keep the discharge under these conditions, which affect phenomena in the discharge gap. The authors investigated a glow discharge in a gas flow at pressure p = 20-80 torr and flow velocity V = 0-30 m/sec. The discharge current was perpendicular to the gas flow. (NL)

Plasma Kinetics (Theoretical)

22933 (IPP-6/139) DIFFERENCE METHODS FOR DIFFUSION EQUATIONS OF PLASMA PHYSICS. Duechs, D.; v. Finckenstein, K. G. F.; v. Hagenow, K. U. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Sep 1975. 43p. (In German). Dep. NTIS (US Sales Only) $4.00.

Various difference methods for certain nonlinear diffusion equations and also systems of such equations are investigated with respect to convergence and stability. For this purpose implicit two-level methods of the Crank-Nicholson type prove to be particularly useful. For these some numerical examples are given. (auth)

22934 (MATT-1181) TRANSPORT EQUATIONS IN AXISYMMETRIC TOROIDAL COORDINATES. Grainick, S. L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 33p. Dep. NTIS $4.00.

A derivation is presented of the conservation law form of the single energy group transport equation in an axisymmetric toroidal coordinate system formed by rotating a nest of smooth, simply closed, plane curves of arbitrary parametric description about an axis which does not intersect the nest. This general equation may be used for generating equations specific to particular cross sec-

tion geometries, or as the basis of a finite difference equation for the general case. The effect of both the toroidal and poloidal curvatures of the system are investigated, and criteria for the validity of cylindrical and planar approximations are established. The diffusion equation for this geometry is derived, and it is shown to be formally homologous to the "r-theta" cylindrical diffusion equation if the coordinate system is orthogonal and if the azimuthal coordinate, phi, is ignorable. (auth)

22935 POSITIVE COLUMN IN ELECTRONEGATIVE GASES. Edgley, P. D.; von Engel, A. (Oxford Univ. (UK). Dept. of Engineering Science). pp 52 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The theory of the positive column is extended to include electron attachment processes involving negative ions. Space charge effects described by Poisson's equation allow the use of realistic boundary conditions to find numerical solutions of this two-point boundary value problem. The results are briefly compared with observations in oxygen discharges. (NL)

22936 NON-NEUTRAL POSITIVE COLUMN INCLUDING ION TEMPERATURE. Franklin, R. N. (Oxford Univ. (UK). Dept. of Engineering Science). pp 53 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The two fluid equations for an isothermal positive column with the ion temperature $T_i \neq 0$ are treated by regarding $\beta = T_i/T_e$ as an expansion parameter. In this way the singularity where the ion velocity = $k_B T_i/M^{\frac{1}{2}}$ is avoided. Solutions to first order are given. (NL)

22937 ELECTRONEGATIVE DISCHARGE PLASMA WITH SPACE CHARGES. Kocian, P. (Ecole Polytechnique Federale, Lausanne (Switzerland)). pp 57 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Continuity equations for charged species in an electronegative discharge plasma have been discussed. The equations have been applied to the most simple electronegative gas — oxygen. It has been shown that the continuity equations cannot be used to determine the spatial distribution of charged particles because of the complexity of reactions occurring in the electronegative plasma. It is shown that this problem can be solved using the impulse conservation equations and Poisson's equation. (NL)

22938 PLASMA-NEUTRAL GAS BOUNDARY LAYERS. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Nucl. Instrum. Methods; 129: No. 1, 31-37(1 Nov 1975).

The plasma-neutral gas balance is considered in the partially ionized transition region situated between a fully ionized magnetically confined plasma and an adjacent neutral gas cloud. A well-defined boundary layer can develop between the plasma and the neutral gas, but only within certain ranges of the relevant parameters such as the plasma density and the magnetic field strength. Consequently, such layers are expected to appear in the atmospheres of normal and magnetic variable stars and in other more dense cosmic clouds of matter, as well as in impermeable laboratory plasmas. On the other hand, sharply defined boundary layers are unlikely to appear in the low-density regions of interstellar and interplanetary space where the plasma becomes permeable to neutral gas and the partially ionized transition region has a minimum depth of the order of $5 \times 10^{18}/n_b m$, where n_b is the corresponding characteristic plasma density. (NL)

22939 THEORETICAL STUDY OF METASTABLE ATOM DIFFUSION IN A POSITIVE COLUMN OF GLOW DISCHARGE. Martisovits, V.; Kosinar, I.; Veis, S. (Dept. of Experimental Physics, Komensky-University, Bratislava, Czechoslovakia). pp 60 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The metastable atom diffusion in a positive column is studied when the volume destruction of the metastability by neutrals and electrons is present. The number density distribution of metastables across a section of the positive column together with the metastable atom flux to the discharge tube wall are calculated. (NL)

22940 INVERSE FARADAY EFFECT IN PLASMAS. Talin, B.; Kaftandjian, V. P.; Klein, L. (Centre de St Jerome, Univ. de Provence, Marseille, France). pp 30 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

A general Kubo response-function formalism is utilized to obtain the induced-magnetization in a plasma perturbed by a circularly polarized wave (inverse Faraday effect). The present treatment allows effects considered elsewhere in plasma susceptibility calculations such as collective effects, thermal motion, etc., to be considered. A physical interpretation of the effect of the angular momentum stored in the plasma is given. (NL)

22941 SELF-CONFINEMENT SOLUTIONS OF THE MHD EQUATIONS FOR A TOROIDAL PLASMA WITH NONCONSTANT CROSS SECTION IN CYCLIDE COORDINATES. Marcilhacy, G. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 1, 25-27(7 Jul 1975). (In French)

MHD equations are written in J.3R rotational coordinate system where two of the coordinate surfaces are cyclides. The self-confinement solutions are derived for a toroidal plasma with nonconstant cross section. (FR)

22942 POLARIZATION CHARACTERISTICS OF SYNCHROTRON EMISSION IN A PLASMA. Stocke, J. T.; Scott, J. S. (Univ. of Arizona, Tucson). Mon. Not. R. Astron. Soc.; 172: No. 3, 567-576(Sep 1975).

The linear and circular polarization emission characteristics are calculated for a power-law distribution of electron energies in a weak plasma in an attempt to differentiate the Razin-Tsytovich effect from other low-frequency turnover mechanisms in radio sources. Both π_L and π_V are found to be slightly larger in the cut-off region than in a vacuum. The detailed dependences are then compared to those available for other mechanisms. (auth)

22943 INFLUENCE OF SELF-FIELDS ON THE VLASOV EQUILIBRIUM AND STABILITY PROPERTIES OF RELATIVISTIC ELECTRON BEAM-PLASMA SYSTEMS. Davidson, R.C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Hui, B.H. Ann. Phys. (N.Y.) 94: No. 2, 209-242 (Oct 1975).

The influence of self-fields on the equilibrium and stability properties of relativistic beam-plasma systems is studied within the framework of the Vlasov-Maxwell equations. The analysis is carried out in linear geometry, where the relativistic electron beam propagates through a background plasma (assumed nonrelativistic) along a uniform guide field $B_0\hat{e}_z$. It is assumed that $\nu/\gamma_0 \ll 1$ for the beam electrons (ν is Budker's parameter, and $\gamma_0 mc^2$ is the electron energy), but no a priori assumption is made that the beam density is small (or large) in comparison with the plasma density, or that conditions of charge neutrality or current neutrality prevail in equilibrium. It is shown that the equilibrium self-electric and self-magnetic fields, $E_r^0(r)\,\hat{e}_r$ and $B_\theta^0(r)\,\hat{e}_\theta$, can have a large effect on equilibrium and stability behavior. Equilibrium properties are calculated for beam ($j=b$) and plasma ($j=e,i$) distribution functions of the form $f_b^0(H, P_\theta, P_z) = F(H-\omega_{rb}P_\theta) \times \delta(P_z-P_0)(j=b)$, and $f_j^0(H, P_\theta, P_z) = f_j^0(H-\omega_{rj}P_\theta - V_jP_z - m_jV_j^2/2)$ ($j=e,i$), where H is the energy, P_θ is the canonical angular momentum, P_z is the axial canonical momentum, and ω_{rj} (the angular velocity of mean rotation for $j=b,e,i$), V_j(the mean axial velocity for $J=e,i$), and P_0 are constants. The linearized Vlasov-Maxwell equations are then used to investigate stability properties in circumstances where the equilibrium densities of the various components ($j=b, e, i$) are approximately constant. The corresponding electrostatic dispersion relation and ordinary-mode electromagnetic dispersion relation are derived (including self-field effects) for

body-wave perturbations localized to the beam interior ($r<R_b$). These dispersion relations are analyzed in the limit of a cold beam and cold plasma background, to illustrate the basic effect that lack of charge neutrality and/or current neutrality can have on the two-stream and filamentation instabilities. It is shown that relative rotation (induced by self-fields) between the various components ($j=b, e, i$) can (a) result in modified two-stream instability for propagation nearly perpendicular to $B_0\hat{e}_z$, and (b) significantly extend the band of unstable k_z-values for axial two-stream instability. Moreover, in circumstances where the beam-plasma system is charge-neutralized but not current-neutralized, it is shown that the azimuthal self-magnetic field $B_\theta^0(r)\,\hat{e}_\theta$ has a stabilizing influence on the filamentation instability for ordinary-mode propagation perpendicular to $B_0\hat{e}_z$. (auth)

Plasma Production

22944 (IPP-IV-85) EXPERIMENTAL STUDY OF $\frac{3}{2}\omega_L$ EMISSION FROM A LASER-PRODUCED PLASMA. Pant, H. C.;

Eidmann, K.; Sachsenmaier, P.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Sep 1975. 15p. (CONF-750590-1). Dep. NTIS (US Sales Only) $3.50.

From 8th international conference on laser plasma fusion; Warsaw, Poland (19 May 1975).

The $\frac{3}{2}\omega_L$ emission from various plane targets irradiated by a 20 J/5 ns Neodymium laser pulse was investigated. A threshold as predicted for excitation of the 2 ω_{pe}-decay was observed. (auth)

22945 (UCRL-52000-76-1) ENERGY AND TECHNOLOGY REVIEW. Carr, R. B.; McCleb, C. S.; Prono, J. K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1976. Contract W-7405-Eng-48. 28p. Dep. NTIS $4.00.

Brief discussions of research progress on the following topics are given: (1) lasers and laser applications, (2) advanced energy systems, (3) science and technology, and (4) national security. Some experiments on the in-flight laser irradiation of ammonia pellets are discussed. (MOW)

22946 ELECTRIC EXPLOSION OF A CESIUM WIRE AT PRESSURES UP TO 500 ATM. Dikhter, I.Yu.; Zeigarnik, V.A. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 13: No. 3, 447-454 (May 1975).

The electric explosion of cesium wires in argon was studied at pressures of up to 500 atm, and the results were interpreted in terms of the conductivity, density, and concentrations of the electrons and heavy particles in the plasma so formed. The parameter γ representing the deviation from the ideal state was very close to unity. Models relating to the development of the discharge in vacuo and at high pressures are discussed. (auth)

Plasma Stability

22947 (AD-720995) VISCOUS EFFECTS ON THE RAYLEIGH-TAYLOR INSTABILITY. Compton, L. M. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Feb 1971. 53p. (ECOM-3392).

The gravitational instabilities of a system consisting of two homogeneous fluids in a concentric cylindrical configuration (θ-pinch), in the presence of a uniform axial magnetic field, are investigated. The fluids are assumed to be incompressible, and viscous, with infinite conductivity. The dispersion relation is developed by two methods. In the first, an exact determination is made based upon the time development of an infinitesimal disturbance of the equilibrium conditions. In the second, it is shown that it is possible to use a variational calculation regardless of whether the system is self-adjoint. (auth)

22948 (AD-737483) COLLISIONAL DRIFT-TYPE INSTABILITY OF A WEAKLY IONIZED MAGNETOPLASMA WITH NO AXIAL DRIFT. Powers, E. J.; Mumola, P. (Texas Univ., Austin (USA). Electronics Research Center). Feb 1971. Contract AF-AFROSR-1792-59. 19p.

The results of a theoretical and experimental study of the stability of inhomogeneous weakly ionized magnetoplasmas with no axial drift are reported. The study is carried out in the regime where $(\omega\tau)_e > 1$ and $(\omega\tau)_i \ll 1$. A linearized two-fluid hydrodynamic stability analysis yields a dispersion relation which is analyzed numerically. Oscillations with an azimuthal phase velocity approximately equal to the electron diamagnetic drift are predicted to become unstable (onset) once the external magnetic field exceeds some critical value. Stability criteria are displayed graphically in terms of the magnetic field strength, neutral gas pressure, and discharge tube radius. Experimental measurements, which were made in a radio-frequency excited magnetoplasma, are found to be in excellent agreement with the predicted values of critical magnetic field and phase velocity over a wide range of neutral gas pressures and several different discharge tube radii. (auth)

22949 (AD-774383) THEORY OF LOCAL HYDROMAGNETIC STABILITY OF TOROIDAL PLASMA CONFIGURATIONS. Mikhailovskii, A. B. (Foreign Technology Div., Wright-Patterson AFB, Ohio (USA)). Dec 1973. 24p. (FTD-HT-23-747-74).

It is pointed out that despite an abundance of investigations of hydromagnetic stability of toroidal plasma configurations, the problem still remains unsolved. In particular, the meaning of the general geometric mercier criterion which plays an important role in modern calculations of stability of concrete systems remains unclear. A general theory of local instability is developed in the present paper from which it followed that the Mercier criterion is a necessary and sufficient condition for plasma stability with respect to a particular class of local perturbations, such as those for which the radial wavelength is small with respect to the wavelength along the small azimuth. (auth)

22950 (AD-889982) SOME OBSERVATIONS OF A LINEAR SCREW-PINCH DISCHARGE. Kyoshi, H.; Takayoshi, O. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1971. 27p. (IPPJ-108).

Plasma properties in a linear screw-pinch discharge are investigated on the problems of the production and the stability. This device is characterized in that the half periods of both Z- and theta-currents are as long as 32 microsec. Plasma behaviors are observed for different time intervals between starts of Z- and theta-pinch discharge, and the preionization, the Z-pinch discharge in this experiment, is necessary for the uniform and reproducible discharge. The electron temperature and density measured by laser scattering and interferometry are $<$ or $\cong$ 10 eV and $\sim$ 10 to the 16th power per cc, respectively, in a normal pressure region. The sudden collapse of the outer region of the plasma column near the current maximum is observed at certain conditions and its reason and suppression are considered. The magnetohydrodynamic stability is also investigated, taking into account the distributed current, to explain the mode m = 2 which appears even within the Kruskal-Shafranov limit in the experiment. The effect of the superposition of the high frequency Z-current is examined with a relation to the dynamic stabilization. (auth)

22951 (AD-920236) HYDROMAGNETIC STABILITY STUDIES USING THE FINITE ELEMENT METHOD. Boyd, T. J. M.; Gardner, G. A.; Gardner, L. R. T. (University Coll. of North Wales, Bangor (UK)). Nov 1973. 37p.

The hydromagnetic stability of a linear pinch is studied numerically using finite element method. The plasma vacuum region is subdivided into a number of elements within each of which displacements are expressed in terms of a small number of nodal values which are taken as parameters of the Lagrangian. The problem is solved by minimizing this function numerically with respect to the nodal values. The results of the numerical analysis are compared with analytic results and with other numerical results where these exist. In particular the variation of the growth rate of M = -2 modes with axial magnetic field and with ratio of the plasma to vacuum radius has been examined. In the appropriate limits the theoretical results are reproduced. Uniform, parabolic and exponential current density profiles have been treated. The number of radial elements has been varied to demonstrate convergence of the solution. A linear pinch with elliptic cross section has also been studied as a preliminary to using the finite element method to analyze toroidal belt pinch configurations. (auth)

22952 (AD/A-000540) STUDY OF THE MHD INSTABILITIES OF A CYLINDRICAL BELT PINCH USING THE FINITE ELEMENT METHOD. Gardner, L. R. T.; Gardner, G. A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1974. Contract F44620-72-C-0016. 22p. (UNICP-SR-103).

The hydromagnetic stability of a cylindrical pinch of rectangular cross section is studied numerically using the finite element method. The plasma is subdivided into a number of rectangular elements within each of which the perturbations are expressed in terms of nodal values which are taken as parameters of a Lagrangian. Minimizing the Lagrangian with respect to these variables produces an eigenvalue problem. The stability of the pinch is determined from the eigenvalues. (auth)

22953 (AD/A-004129) SHEAR STABILIZATION OF DRIFT WAVES: A NEW APPROACH. Bakshi, P.; Bellew, W. (Boston Coll., Chestnut Hill, Mass. (USA). Dept. of Physics). Sep 1974. 29p.

The problem of shear stabilization of drift waves is studied, introducing a new operator method for the solution of the Vlasov equation which allows a more complete determination of the perturbed distribution and density operators. The resulting equations, even when treated in the second order differential equation approximation, lead to modifications in the presently available stability criteria. These methods may prove useful for the study of various instabilities in fusion related confinement systems with strong density and magnetic field variations. (auth)

22954 (AD/B-002645) KINK INSTABILITY OF A CYLINDRICAL TOKAMAK WITH AN ARBITRARY CURRENT DISTRIBUTION. Itoh, K.; Yoshikawa, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 15p. (IPPJ-207).

A new method to analyze the MHD kink instability in the cylindrical approximation is presented. Using the nonlinear equilibrium equation with the helical perturbation method, an expression for the growth rate of instability of a perturbation is obtained. For M = 1 mode, the growth rate and the stability-instability criterion, Q(A) = 1, are calculated analytically for an arbitrary current distribution. The growth rate is also calculated in the case of a uniform current. (auth)

22955 (AD/B-002650) HELICAL EQUILIBRIA AND CRITERIA FOR THE KINK INSTABILITY OF CYLINDRICAL TOKAMAK. Inoue, S.; Itoh, K.; Yoshikawa, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1974. 12p.

Helical equilibria and criteria for the kink instability have been obtained numerically for various current distribution, including camel hump distribution. It is found that the unstable region expressed by Q(A) is the largest in the case of uniform current. (auth)

22956 (ERDA-tr-70, pp 3-22) INVESTIGATING EQUILIBRIUM AND HYDRODYNAMIC STABILITY OF CURRENT PLASMA IN URAGAN-1 STELLARATOR. Dikii, A. G.; Zalkind, V. M.; Konovalov, V. G.; Kotsubanov, V. D.; Kuznetsov, Yu. K.; Pashnev, V. K.; Pavlichenko, O. S.; Suprunenko, V. A.; Tonkopryad, V. M. 31 Oct 1974. Translated from pp 4-15 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

Experimental studies were made to determine to what extent the breakdown of equilibrium and hydrodynamic stability were responsible for the observed particle losses. The experimental conditions on current heating of the plasma and the measurement methods used were described. Studies on a system for the automatic stabilization of the perturbation of the current plasma were also discussed. (JSR)

22957 (IPP-1/156) BELT PINCH: A HIGH-β TOKAMAK WITH NON-CIRCULAR CROSS-SECTION. Gruber, O.; Peiry, J. M.; Wilhelm, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1975. 44p. Dep. NTIS (US Sales Only) $4.00.

In a Tokamak the attainable β values are restricted by the limitations of MHD stability. But the necessary improvement of the β value should be possible by the transition to a noncircular plasma cross-section. The theoretical conditions for such an improvement are discussed (e.g., volume currents peaked on axis, flattened ends of the elongated cross-section and diamagnetic plasma). Experimental investigations of this problem were carried out in the Belt Pinch, where plasma production and heating is achieved by fast magnetic compression. This heating method is unusual for a Tokamak, but is for the present the only way to approach the interesting β-regime ($\langle\beta\rangle \approx$ 10 – 50%) and especially $\beta_{pol} > 1$ operation. (auth)

22958 (MATT-1188) ANOMALOUS TRANSPORT AND STABILIZATION OF COLLISIONLESS DRIFT-WAVE INSTABILITIES. Lee, W. W.; Okuda, H. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 16p. Dep. NTIS $3.50.

Extensive numerical simulations have been carried out to study the enhanced transport processes associated with the collisionless drift wave instabilities. The results indicate that the shear is effective in reducing the anomalous particle diffusion as predicted by theory; however, it is less so for the accompanied electron heat transfer. The quasilinear decay of the density profile is found to be the dominant mechanism for the nonlinear saturation. (auth)

22959 PARAMETRIC INSTABILITIES IN STRONGLY RELATIVISTIC, PLANE-POLARIZED ELECTROMAGNETIC WAVES. Drake, J.F.; Lee, Y.C.; Tsintsadze, N.L. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 36: No. 1, 31-34 (5 Jan 1976).

We investigate the stability of long-wavelength, plane-polarized electromagnetic waves when the oscillatory energy of the electrons exceeds their rest energy. The strong electron-mass variation destabilizes electron modes polarized along the electric field of the pump $\vec{E}_0$. The electron and ion modes decouple in the presence of such an intense pump and hence the ions do not strongly influence the instability. (auth)

22960 EXPLOSIVE INSTABILITY OF DRIFT-CONE MODES IN MIRROR MACHINES. Liu, C.S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Aamodt, R.E. Phys. Rev. Lett. 36: No. 2, 95-98 (12 Jan 1976).

We examine the parametric coupling of the negative-energy drift-cone mode near the ion-cyclotron frequency with lower-frequency positive-energy modes through the electronic nonlinearity. This parametric process is shown to be stabilized by azimuthal asymmetry occurring in the early stage of the buildup. The theory is compared with the experimental observations. (auth)

22961 SIMULTANEOUS MEASUREMENTS OF THE PLASMA CURRENT PROFILE AND INSTABILITIES IN A TOKAMAK. Makishima, K.; Tominaga, T.; Tohyama, H.; Yoshikawa, S. (Department of Physics, University of Tokyo, Tokyo, Japan). Phys. Rev. Lett. 36: No. 3, 142-145 (19 Jan 1976).

In a small-scale tokamak, magnetohydrodynamic instabilities of small wave numbers, including the $m=1$ mode with positive voltage spikes, were observed. They were identified as kink modes and resistive tearing modes, by a direct measurement of the plasma current profile. Relations between the fluctuations and the current profile show a qualitative agreement with the theory of kink and resistive tearing modes. (auth)

22962 LINEAR INSTABILITIES OF A CYLINDRICAL PLASMA COLUMN IN THE GUIDING-CENTER APPROXIMATION. Shoucri, M. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). J. Appl. Phys. 47: No. 2, 518-521 (Feb 1976).

The linearized three-dimensional guiding-center equations for a plasma of cold ions and thermal electrons are solved in a cylindrical geometry. Conditions under which solutions of the disperion relation with complex frequencies can exist are determined. The consequences on the possibility of developing a "plasma magnetron", where the electron fluid of a classical magnetron is substituted by a guiding-center plasma, are discussed. (auth)

22963 PLASMA TRAPPING IN THE TWO-STREAM INSTABILITY. Astrelin, V.T.; Buchel'nikova, N.S.; N.S.; Zakharov, Yu.P. (Institute of Nuclear Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.—Tech. Phys. 20: No. 6, 741-750 (June 1975).

A numerical experiment employing the particle-in-cell method is used to investigate the influence of plasma on the development of a monochromatic wave in the instability in a monochromatic beam and in a beam with a slight spread. When the nonlinear stage of the instability is governed solely by beam trapping the results of the numerical experiment for a monochromatic beam are close to the theoretical results. At low beam velocities the strong plasma-wave interaction and trapping of the plasma reduce the maximum energy of the electric field and increase the energy of the plasma oscillations. (auth)

22964 EXPLOSIVE ALFVÉN-WAVE INSTABILITY IN A NEUTRAL-BEAM-PLASMA SYSTEM. Fainshtein, S.M. (A. A. Zhdanov Polytechnical Institute, Gor'kii). Sov. Phys.—Tech. Phys. 20: No. 6, 841-842 (June 1975).

In an analysis of the explosive instability for Alfvén waves in a nonisothermal plasma penetrated by a neutralized, monoenergetic beam of charged particles it is shown that the Alfvén waves are excited efficiently by the instability. The limitations on wave amplitudes are found. Appropriate calculations are carried out for a laboratory plasma. (auth)

22965 CURRENT-DRIVEN INSTABILITY IN MOLECULAR GASES. Menakhin, L.P.; Eroshchenkov, E.K.; Ul'yanov, K.N. Sov. Phys.—Tech. Phys. 20: No. 6, 851-853 (June 1975).

An experimental study has been made of the current-driven instability in non-self-maintained glow discharges in molecular gases (N_2, CO_2, and He) at pressures of 150 and 760 torr and for various current densities of the electron beam. The basic purpose of the experiments is to obtain qualitative relations for the stability threshold and in the unstable region. Various instability mechanisms are discussed. (auth)

22966 STATIONARY SHORT-WAVE ION-ACOUSTIC TURBULENCE IN A CURRENT-CARRYING PLASMA. Pustovalov, V.V.; Silin, V.P.; Tikhonchuk, V.T. (P. M. Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Phys.—Tech. Phys. 20: No. 3, 289-291 (Mar 1975).

Using the theory of weak plasma turbulence an expression is found for the effective collision frequency experienced by an electron current that excites ion-acoustic waves in a nonisothermal plasma. The ion-acoustic wave is stabilized by ion scattering. The acoustic energy per unit plasma volume is determined. (auth)

22967 KINETIC CYCLOTRON INSTABILITY IN A BEAM—PLASMA SYSTEM. Fedorenko, V.N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 3, 313-317 (Mar 1975).

A kinetic electrostatic instability with frequencies of the order of the electron gyrofrequency is studied in a beam—plasma system. Under conditions typical of present experiments these waves are excited at large angles to the normal of the magnetic field. The theory agrees with the experiments. (auth)

22968 LOW-FREQUENCY DRIFT INSTABILITY IN A HIGH-FREQUENCY DISCHARGE IN A MAGNETIC FIELD. Postnikov, S.A.; Skovoroda, A.A.; Shvilkin, B.N. (M. V. Lomonosov State University, Moscow). Sov. Phys.—Tech. Phys. 20: No. 3, 318-321 (Mar 1975).

An experimental investigation of unstable low-frequency oscillations in a high-frequency discharge plasma in a magnetic field is described. Information is given on the instability regions and the dispersion relation. The theory of low-frequency drift oscillations developed recently by Timofeev and Putvinskii is used. Comparison of the calculated and experimental data shows good agreement. (auth)

22969 ROLE OF RUNAWAY ELECTRONS IN TOKAMAK INSTABILITIES. Alikaev, V.V.; Arsen'ev, Yu.I.; Bobrovskii, G.A.; Kondrat'ev, A.A.; Razumova, K.A. Sov. Phys.—Tech. Phys. 20: No. 3, 322-326 (Mar 1975).

The instability of a low-density plasma with a large safety factor is studied in the TM-3 tokamak. This instability has the earmarks of the previously detected disruptive instability. Plasma x-ray emission and the usual discharge properties are studied. It is concluded from the experiments that runaway electrons are important in this instability. (auth)

22970 MICROWAVE ABSORPTION IN THE TM-3 TOKAMAK. Alikaev, V.V.; Arsen'ev, Yu.I.; Bobrovskii, G.A.; Poznyak, V.I.; Razumova, K.A.; Sokolov, Yu.A. (I. V. Kurchatov Institute of Atomic Energy, Moscow). Sov. Phys.—Tech. Phys. 20: No. 3, 327-329 (Mar 1975).

The microwave absorption is studied with $\omega_{He} > \omega \gtrsim \sqrt{\omega_{He}\omega_{Hi}}$ and $\omega_{pe} > \omega \gtrsim \omega_{pi}$. Significant microwave absorption is observed over the entire parameter range of the plasma. The absorption is accompanied by ion heating, additional displacement of the plasma, and the appearance of hard x rays. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 24270, 24319, and 25274.

22971 (AD-728571) INVESTIGATION OF THETA-PINCH PRODUCED SHOCK WAVES IN A PLASMA. Christensen, C. L. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1971. 59p.

Thesis.

The report discusses the completion and operational testing of the theta pinch experiment at the Naval Postgraduate School Plasma Facility. The system consists of a 42 micro F capacitor bank feeding a single turn theta pinch coil with a total energy capacity of 13.1 kj. Included is a brief discussion of the theory of shock wave generation and propagation in a plasma along with experimental verification of reproducible hydrodynamic shock waves of mach about 16 produced in a neutral argon gas at 0.1 torr. Calculations based on the theory of shock wave thicknesses (3 cm.) are compared to observed values (10 cm.) at this pressure. An outline of proposed future experiments at the plasma facility is included in the recommendations. (auth)

22972 (AD/A-001301) ROTATIONAL STABILIZATION OF IDEALIZED LINEARS. Cooper, A. L.; Barcilon, A. (Naval Research Lab., Washington, D. C. (USA)). Oct 1974. 23p. (NRL-MR-2901).

The stabilizing effects of rotation on the basic state of an idealized, imploding, liquid liner are studied. Conventional Rayleigh-Taylor stability analysis predicts that a layer of fluid is unstable when the density gradient and the acceleration are antiparallel. At the inner turning point (ITP) in the absence of rotation, an imploding, liquid liner has an unstable inner surface, and a stable outer surface. Centrifugal acceleration, due to rotation, could offset the destabilization of the inner surface without destabilizing the outer one. (auth)

22973 (BNL-20731) SYSTEMS STUDIES OF DUAL PURPOSE ELECTRIC/SYNTHETIC FUELS FUSION PLANTS. Beardsworth, E.; Powell, J. (Brookhaven National Lab., Upton, N. Y. (USA)). Feb 1975. 53p. (CONF-750607-40). Dep. NTIS $4.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A reactor power plant is proposed that can meet base load electrical demand, while the remainder can generate synthetic fuels and meet intermittent electrical demands. Two principal objectives of this study are: (1) to examine how strongly various economic demand and resource factors affect the amount of installed CTR capacity, and (2) to examine what increase in CTR capacity can be expected with dual purpose electric/synthetic fuel fusion plants, and also the relative importance of the different production modes. (MOW)

22974 (CONF-751125-106) PDX VACUUM VESSEL STRESS ANALYSIS. Nikodem, Z. D. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 9p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A stress analysis of PDX vacuum vessel is described and the summary of results is presented. The vacuum vessel is treated as a toroidal shell of revolution subjected to an internal vacuum. The critical buckling pressure is calculated. The effects of the geometrical discontinuity at the juncture of toroidal shell head and cylindrical outside wall, and the concavity of the cylindrical wall are examined. An effect of the poloidal field coil supports and the vessel outside supports on the stress distribution in the vacuum vessel is determined. A method evaluating the influence of circular ports in the vessel wall on the stress level in the vessel is outlined. (auth)

22975 (CONF-751125-107) PDX TOROIDAL FIELD COILS STRESS ANALYSIS. Nikodem, Z. D.; Smith, R. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.; Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1975. 4p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A method used in the stress analysis of the PDX toroidal field coil is developed. A multilayer coil design of arbitrary dimensions in the shape of either a circle or an oval is considered. The analytical model of the coil and the supporting coil case with connections to the main support structure is analyzed using the finite element technique. The three dimensional magnetic fields and the non-uniform body forces which are a loading condition on a coil due to toroidal and poloidal fields are calculated. The method of analysis permits rapid and economic evaluations of design changes in coil geometry as well as in coil support structures. Some results pertinent to the design evolution and their comparison are discussed. The results of the detailed stress analysis of the final coil design due to toroidal field, poloidal field and temperature loads are presented. (auth)

22976 (CONF-751125-115) PULSED POWER LINER FOR PLT ENERGY SYSTEMS. Armellino, C. A.; Bronner, G.; Murray, J. G. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 5p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

PLT is Princeton University's latest Tokamak machine in the controlled thermonuclear fusion research effort. The OH (ohmic heating) and SF (shaping field) systems for the machine place a very high energy pulsed current load on the AC line feeding them. This paper describes the two systems and the steps taken to insure minimum effect on line regulation during the pulsed operation. (auth)

22977 (CONF-751125-123) SILVER BRAZING METHODS FOR JOINING THE OH AND SF FIELD COIL TURNS FOR THE PLT MACHINE. Bahr, M. W. G.; Heitzenroeder, P. J. Jr.; Johnson, H. G. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 5p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the techniques, materials, and equipment used to silver-braze the OH and SF field coils in-place in the PLT machine. (auth)

22978 (CONF-751125-126) MAGNETIC FIELD FROM ARBITRARILY SHAPED FLAT COILS WITH FILAMENTARY, RIBBON, AND RECTANGULAR CROSS SECTIONS. Weissenburger, D. W.; Christensen, U. R. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 7p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This report describes the derivation of three groups of equations: (1) Field components from an arbitrarily shaped filament lying in a plane. (2) Field components from an arbitrarily shaped ribbon of infinitesimal thickness with center line lying in a plane. (3) Field components from an arbitrarily shaped bar of rectangular cross section with its center line lying in a plane. In all three cases analytical expressions for the field components were found for an infinitesimal element of the cross section. These expressions are then integrated numerically along the arbitrarily shaped center line of the coil to obtain the three field components. As a check for accuracy the calculated field values of an elliptically shaped coil were compared to an existing analytic expression for a filamentary elliptical coil. (auth)

22979 (CONF-751125-127) LOW NOISE CONTROL VALVE. Christie, R. S. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1975. 16p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Noise is one of the problems associated with the use of any type of control valve in systems involving the flow of fluids. The advent of OSHA standards has prompted control valve manufacturers to design valves with special trim to lower the sound pressure level to meet these standards. However, these levels are in some cases too high, particularly when a valve must be located in or near an area where people are working at tasks requiring

a high degree of concentration. Such locations are found around and near research devices and in laboratory-office areas. This paper describes a type of fluid control device presently being used at PPL as a bypass control valve in deionized water systems and designed to reduce sound pressure levels considerably below OSHA standards. Details of the design and construction of this constant pressure drop variable flow control valve are contained in the text and are shown in photographs and drawings. Test data taken are included. (auth)

22980 (CONF-760207-1) TOKAMAK FUSION TEST REACTOR EXPERIMENT. Furth, H. P. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1976. 4p. Dep. NTIS $3.50.

From annual meeting of APS; New York, New York, United States of America (USA) (2 Feb 1976).

A brief review of the TFTR is given in terms of the physical size of the experiment in relation to existing and future tokamaks. Some break-even criteria are mentioned. (MOW)

22981 (CONF-760209-1) CHANGES IN SURFACE CONDITIONS WITH FIRST PLASMA IN THE PRINCETON LARGE TORUS (PLT). Dylla, H. F.; Cohen, S. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1976. 14p. Dep. NTIS $3.50.

In-situ measurements are reported of the changes in surface composition of 305 stainless steel exposed to the first plasma discharges in PLT. Auger electron spectroscopy of pre-exposure surfaces shows a multilayer coverage of carbon and a fractional monolayer coverage of oxygen. Surfaces subjected to increasing levels of plasma exposure show substantial removal of the carbon multilayer, increased fractional-monolayer coverages of oxygen and iron, and tenth-monolayer quantities of chlorine and sulfur. (auth)

22982 (CONF-760209-2) IMPURITY AND SURFACE STUDIES IN ORMAK. Colchin, R. J.; Bush, C. E.; Jahns, G. L.; Lyon, J. F.; Murakami, M.; Neidigh, R. V.; Shaeffer, D. L. (Oak Ridge National Lab., Tenn. (USA)). 1976. 22p. Dep. NTIS $3.50.

From second international conference on surface effects in controlled fusion devices; San Francisco, California, United States of American (USA) (16 Feb 1976).

The ORMAK tokamak has been in operation since 1971, and surface impurity problems have been pursued from the beginning. Surface studies of materials removed from ORMAK have revealed the presence of C, O, and Fe. These are also the principal impurities observed spectroscopically in plasma discharges, although numerous other elements are present in lesser amounts. Spectroscopy, x-ray measurements, plasma resistance, and fast ion scattering have been used in an effort to determine Z/sub eff/, the effective nuclear charge of plasma ions. All four measurements have practical difficulties leading to relatively large experimental error limits. Oxygen discharge pre-cleaning has allowed ORMAK discharges to reach higher currents and correspondingly higher ion and electron temperatures; spectroscopic studies reveal a lower level of contaminants, particularly C and N. Power measurements indicate that most of the input power strikes the walls, mostly as radiation. By varying operating parameters it is found that Z/sub eff/ approximately I/sub p//anti n/sub e/. (auth)

22983 (CONF-760209-5) NEUTRON DAMAGE CALCULATIONS IN Cu, Nb, AND Au TO 32 MeV: APPLICATION TO SPUTTERING AND DEUTERON-BREAKUP NEUTRON SOURCES. Roberto, J. B.; Robinson, M. T.; Fu, C. Y. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. 20p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Primary recoil distributions and specific damage energies have been computed for high energy deuteron-breakup neutrons in Cu, Nb, and Au. The calculations are based on theoretical neutron cross sections, and consider in particular a d-Be spectrum broadly peaked at 15 MeV with some neutrons above 30 MeV. The theoretical results are similar to corresponding calculations for monoenergetic 15-MeV neutrons and are in good agreement with range measurements of (n,2n) recoils generated by high energy d-Be neutrons in Nb and Au. The calculations are also consistent with recent d-Be neutron sputtering experiments in Nb and Au and demonstrate the usefulness of deuteron-breakup neutron sources for simulating fusion neutron effects. (auth)

22984 (CONF-760209-6) CHARACTERISTICS OF 15 MeV AND FISSION NEUTRON DAMAGE IN NIOBIUM. Narayan, J., Ohr, S. M. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. 18p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Displacement damage by 15 MeV (d-Be source) and fission neutrons at 30°C in high purity niobium single crystals has been studied by transmission electron microscopy. The fluence of the 15 MeV neutrons was 1.5–2.0 x 10^{17} n/cm^2 and the fluence of the fission neutrons (5 x 10^{17} n/cm^2) was chosen so that samples from both types of irradiations had approximately the same damage energy. In both 15 MeV and fission neutron irradiated specimens, the loops were observed to be about ⅔ interstitial and ⅓ vacancy type. The analysis of Burgers vectors of the dislocation loops showed that more than ⅔ of the loops were perfect a/2(111) and that the rest were a/2(110) faulted. It is concluded that at equal damage energies, the detailed nature of the damage is the same for 15 MeV and fission neutron irradiated niobium. (auth)

22985 (CONF-760209-7) ISX: A TOKAMAK FOR SURFACE AND IMPURITIES STUDIES. Colchin, R. J.; Jernigan, T. C. (Oak Ridge National Lab., Tenn. (USA)). 1976. 22p. Dep. NTIS $3.50.

From second international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The ISX (Impurity Study Experiment) is a moderate size tokamak slightly larger than the ORMAK tokamak. ISX is being built explicitly for the study of impurities and plasma-wall interactions. It is scheduled to begin experiments in the spring of 1977. Several features have been deliberately designed into the ISX which make it particularly adaptable to surface studies. The first is a welded stainless steel vacuum system, bakeable to 400°C, with a projected base pressure greater than or equal to 2 x 10^{-9} torr. Another feature is that of "easy" demountability of the vacuum system. Replacement of the entire vacuum system should take about two weeks. A third feature is diagnostic access to the edges of the plasma. The initial surface physics question to be answered is how best to keep surfaces clean: by baking, by direct or indirect wall bombardment discharges, or by gettering. Later experiments will involve using wall materials other than stainless steel to determine their effects on the plasma. (auth)

22986 (CONF-760209-13) RADIATION BLISTERING OF Nb IMPLANTED SEQUENTIALLY WITH HELIUM IONS OF DIFFERENT ENERGIES (3-500 keV). Guseva, M. I.; Gusev, V.; Krasulin, U. L.; Martinenko, U. V.; Das, S. K.; Kaminsky, M. S. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 15p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Cold rolled, polycrystalline niobium samples were irradiated at room temperature with $^4He^+$ ions sequentially at 14 different energies over an energy range from 3 keV–500 keV. The dose for each energy was chosen to give an approximately uniform concentration of helium between the implant depths corresponding to 3 keV and 500 keV. In one set of experiments the irradiations were started at the Kurchatov Institute with 3 keV $^4He^+$ ions and extended up to 80 keV in several steps. Subsequently, the same target area was irradiated with $^4He^+$ ions at Argonne National Laboratory (ANL) starting at 100 keV and increased to 500 keV in steps of 50 keV. Another set of irradiations was started at ANL with 500 keV $^4He^+$ ions and continued with decreasing ion energies to 100 keV. Subsequently, the same area was irradiated at the Kurchatov Institute starting at 80 keV and continued with decreasing ion energies to 3 keV. Both sets of irradiations were completed for two different total doses, 0.5 C cm^{-2} and 1.0 C cm^{-2}.

22987 (CONF-760209-14) REDUCTION OF SURFACE EROSION CAUSED BY HELIUM BLISTERING IN SINTERED BERYLLIUM AND SINTERED ALUMINUM POWDER. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 17p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Studies have been conducted to find materials with microstructures which minimize the formation of blisters. A promising class of materials appears to be sintered metal powder with small average grain sizes and low atomic number Z. Studies of the surface erosion of sintered aluminum powder (SAP 895) and of aluminum held at 400°C due to blistering by 100 keV helium ions have been conducted and the results are compared to those obtained earlier for room temperature irradiation. A significant reduction of the erosion rate in SAP 895 in comparison to annealed aluminum and SAP 930 is observed. In addition results on the blistering of sintered beryllium powder (type I) irradiated at room temperature and 600°C by 100 keV helium ions are given. These results will be compared with those reported recently for vacuum cast beryllium foil and a foil of sintered beryllium powder (type II) which was

fabricated differently, than type I. For room temperature irradiation only a few blisters could be observed in sintered beryllium powder type I and type II and they are smaller in size and in number than in vacuum cast beryllium. For irradiation at 600°C large scale exfoliation of blisters was observed for vacuum cast beryllium but much less exfoliation was seen for sintered beryllium powder, type I, and type II. The results show a reduction in erosion rate cast beryllium, for both room temperature and 600°C.

22988 (CONF-760209-15) X-RAY IMPACT INDUCED DESORPTION OF GASES FROM SURFACES. Brumbach, S.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). Feb 1976. Contract W-31-109-Eng-38. 13p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Measurements of gases released from 302 stainless steel and gold surfaces before and after discharge cleaning were made in ultrahigh vacuum using x-rays with an energy distribution typical of a tungsten bremsstrahlung spectrum. Similar measurements were also made for Al_2O_3 surfaces which had not been discharge cleaned. For the non-discharge-cleaned surfaces of stainless steel, Al_2O_3, and gold the predominant gas species observed mass spectrometrically was CO_2. For some stainless steel and Al_2O_3 surfaces CO and O_2 were also readily observed. Mean quantum yields for CO, O_2 and CO_2 release from such stainless steel surfaces, for example, ranged from less than 6×10^{-5} to 9×10^{-4} molecules per photons in the bremsstrahlung spectrum characteristic for 50 keV electron energy. After discharge cleaning a decrease in the mean quantum yields was observed for the stainless steel and gold surfaces. (auth)

22989 (CONF-760209-16) SPUTTERING OF VANADIUM AND NIOBIUM UNDER 14.1 MeV NEUTRON IMPACT. Kaminsky, M.; Das, S. K. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 13p. Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

The recent studies of particle emission from cold-rolled and annealed niobium under 14.1-MeV neutron impact were extended to a heavily etched, polycrystalline niobium surface and to cold worked vanadium surfaces with different degrees of microstructure. The type and amount of material released and deposited on collector surfaces facing the irradiated targets were determined by three analytical techniques. Two types of deposits were found for certain types of surfaces—one in the form of chunks, the other as a fractional atom layer covering the surface. The chunks vary significantly in size. The small number of chunks observed suggests that the ejection of chunks is a relatively rare event in comparison to the total number of primary knock-on events produced by 14-MeV neutrons in near surface regions. Estimates of the total sputtering yield based on the chunk deposits and on the fractional atom layer deposit will be given. (auth)

22990 (ERDA-1548(Draft)) INTENSE NEUTRON SOURCE FACILITY, LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO. Draft Environmental Statement. (Energy Research and Development Administration, Washington, D. C. (USA)). Jan 1976. 232p. USERDA, Washington, DC.

Two neutron sources are planned for the INS facility, each designed to produce 10^{15} 14-MeV neutrons per second continuously and for long periods of time. These intense sources of fusion neutrons are achieved by intersecting an accelerated tritium ion beam and a supersonic jet of deuterium gas. The handling of the tritium and deuterium will provide experience of considerable value to the fusion power program. The purpose of the proposed project is to provide an experimental facility for national and international use in materials research and development using fusion-energy neutrons. The facility will provide a neutronic environment accessible for experimental irradiations similar to the radiation environment anticipated in a fully operational fusion-power reactor. In particular, the effects of high-level neutron irradiation on metals and insulators used in controlled thermonuclear research may be studied (TFD)

22991 (ERDA-tr-70, pp 109-119) EFFECT OF MAGNETIC SURFACE PARAMETERS ON LOW-FREQUENCY PLASMA FLUCTUATIONS. Voytsenya, V. S.; Voloshko, A. Yu.; Solodovchenko, S. I.; Tereshchenko, F. F.; Zakharov, A. P. 31 Oct 1974. Translated from pp 70-75 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

The results of an investigation of the effects of some parameters of the magnetic surface (mean min B and width) on the behavior of the low-frequency fluctuations of the plasma of a superhigh frequency discharge in the toroidal stellarator Saturn were reported. The character of the observed oscillations and the effects of wells and antiwells and of width were discussed. (JSR)

22992 (ERDA-tr-70, pp 130-144) MAGNETIC FIELD OF l EQUALS 1 TOROIDAL TORSATRON. Amelin, V. Z.; Georgievskii, A. V.; Ziser, V. E.; Lotz, W.; Peletminskaya, V. G.; Pogozhev, D. P.; Skoblik, M. N.; Suprunenko, V. A. Oct 1974. Translated from pp 82-91 of KHFTI-74-36.

In plasma physics and problems of controlled thermonuclear fusion. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.).

A detailed study was made of the structure of the magnetic field of the l equals 1 toroidal torsatron without special windings of the longitudinal field. The configuration of the magnetic field was characterized by a three-dimensional magnetic axis. It is possible to regulate the parameters of the magnetic surfaces in a wide interval by changing the size of the total vertical field. The magnetic system under the conditions studied was characterized by a high level of inhomogeneity of the magnetic field in the working space. Experimental studies made on the Vint-20 confirmed the computer analysis. (JSR)

22993 (GA-A-13661) CHARACTERISTICS OF A FIRST GENERATION COMMERCIAL FUSION POWER PLANT. Baker, C. C.; Harder, C. R.; Sager, P. H. Jr. (General Atomic Co., San Diego, Calif. (USA)). 11 Dec 1975. Contract E(04-3)-167. 30p. Dep. NTIS $4.00.

A brief survey was made to identify the major design parameters and features of a first generation commercial fusion plant using a noncircular tokamak reactor. This study was made to provide a frame of reference for developing a conceptual design of a demonstration plant which is intended to demonstrate the principal features of a commercial plant on a scalable basis. Based on a review of size trends in the utility industry, the plant was sized to produce about 2200 MW(e) gross output. Allowing for expected parasitic power requirements, the net station output is approximately 1800 MW(e). The plant is described in some detail. (MOW)

22994 (LA-6050-PR) LASER PROGRAM AT LASL. Progress Report, January 1–June 30, 1975. Skoberne, F. (Comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 157p. Dep. NTIS $7.75.

Progress in the development of high-power lasers for fusion application is reported. Modifications to the Nd:glass system are described, and studies relating to specific problems of this system are summarized. Efforts in the development of a powerful CO_2 laser system are outlined, leading from a 1-kJ laser to a 2.5-kJ system and subsequently to a 10-kJ assembly. Results of experiments with the cold-cathode electron gun to be used in the 2.5-kJ system are given. Preliminary design criteria for a high-energy laser facility to accommodate an advanced CO_2 laser system with a nominal energy output of 100 kJ are discussed. Results of experimental studies on the high-gain HF system are presented; and several promising prospective molecular lasing systems are described. New methods of fabricating complex laser targets are summarized, and novel coating and inspection techniques are outlined. The development and testing of new instrumentation and data-acquisition techniques applicable to large laser systems and to experiments of greater complexity are described. Computer-code modifications and developments are discussed which integrate some of the phenomena observed in laser/target interaction experiments. Optimum radii, aspect ratios, and masses of targets for given laser time scales and energies are given, and the role of radiative preheating from a high-Z ablator in explaining the low performance in present laser-fusion experiments is outlined. Major efforts in recent feasibility and systems studies of laser-fusion power plants are described, and applications of laser fusion other than the direct production of electric power, e.g., the production of synthetic fuels, are discussed.

22995 (MATT-1201) EFFECTS OF LOW Z IMPURITIES DURING THE STARTUP PHASE OF A LARGE TOKAMAK. Hawryluk, R. J.; Schmidt, J. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 10p. Dep. NTIS $4.00

The requirements placed on a tokamak ohmic heating system (i.e. loop voltage) to initiate the plasma become more severe as the size increases because of the current density decrease. During the startup phase even small concentrations of low Z impurities can affect the plasma energy balance very substantially and have very important effects on the evolution of the discharge. The startup phase has been studied using a simple zero dimensional computer code. Because the dominant energy loss mechanisms during startup, radiation, and ionization are a volume effect, the zero dimensional code was adequate to treat this phase.

The results of this study which have been applied to TFTR indicate that the plasma evolution is a sensitive function of the applied loop voltage, impurity concentration, initial filling pressure and the manner in which gas is fed into the discharge. (auth)

22996 (NP-20759) EDDY CURRENTS IN THE ALCATOR TOKAMAK. Rijnhuizen Report 75-88. Schram, D. C.; Rem, J. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Mar 1975. 51p. Dep. NTIS (US Sales Only) $4.50.

A one-dimensional model of an aircore transformer is developed through which it is possible to analyze the effect of eddy currents in the primary windings—and of similar currents in the field coils for the toroidal magnetic field—on the time dependence of the current in a Tokamak experiment. The model is applied to the "Alcator" Tokamak at MIT and its accuracy is tested by comparing analytical results for the harmonic behavior of the transformer, with experimental data. The time-dependent behavior of the plasma current—for a constant plasma resistance—shows that eddy currents in the primary windings will lead to a reduction of 8% of the current maximum. The eddy currents in the "Bitter" coils are found to affect predominantly the initial current rise, they lead to a steepening of the current rise. Finally, the influence of the time dependence of the plasma resistance is investigated. (auth)

22997 (NP-20760) BEHAVIOUR OF IMPURITIES IN A STEADY-STATE DT GAS-BLANKET REACTOR. Rijnhuizen Report 75-90. Markvoort, J. A. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Nov 1975. 35p. Dep. NTIS (US Sales Only) $4.00.

A four-fluid model of a cylindrical steady-state DT gas-blanket reactor is analyzed. The four fluids are electrons, deuterium-tritium, helium, and a high-Z impurity. In this model the fuel supply, a 50/50 deuterium-tritium mixture, and the ash removal take place by diffusion, while the fusion energy is carried off by heat conduction in addition to neutron radiation and Bremsstrahlung. The radial temperature gradient and an externally applied magnetic field perpendicular to it, give rise to a thermal force (the Nernst effect) which drives a poloidal current. It is this poloidal current together with the applied axial magnetic field that cause the kinetic pressure to be much larger in the center than at the boundary (for example, 100 atm in the center and 10^{-1} atm at the boundary). The behavior of the plasma is described by the multi-fluid MHD-equations which are numerically solved with the aid of a Runge Kutta method. (auth)

22998 (NP-20761) HYDROGEN AND HELIUM DENSITY PROFILES IN A STEADY-STATE GAS-BLANKET REACTOR. Rijnhuizen Report 75-91. Markvoort, J. A. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Nov 1975. 112p. Dep. NTIS (US Sales Only) $5.50.

A steady-state DT gas-blanket reactor is analyzed. The behavior of the plasma in the reactor, consisting of electrons, a 50/50 deuterium-tritium mixture, and helium, is described by the multi-fluid MHD-equations. The set of equations differs in one important aspect from the usual ones as the thermo-electric forces arising from both electron-ion and ion-ion collisions are taken into account. The equations are numerically solved with the aid of a Runge Kutta method. The formula of Braginskii for the so-called Nernst effect, which only considers the electron-ion collisions is generalized to include collisions between ions with arbitrary charges and masses. It is shown that the influence of the thermoforce due to ion-ion collisions on the density profiles is larger than the force due to the electron-ion collisions. Case studies have been made to evaluate the effect of the Nernst thermoforce on simple hydrogen arcs, which are ohmically heated. This has been done to estimate the ratio of the kinetic pressure to the magnetic pressure at which the density profiles are not dominated anymore by the Nernst effect, but by the radial pinching effect in such an arc. Finally, in order to study toroidal reactor systems similar to the above-mentioned linear reactor it is investigated if an infinitely high "belt" configuration with axial symmetry may be an acceptable substitute for a torus. For this ideal "belt" the calculation of the classical diffusion indeed shows a contribution due to the curvature of the magnetic field for conditions under which, generally, the plasma dynamics in a torus are studied. (auth)

22999 (NP-20785) BEHAVIOR OF IMPURITIES IN A STEADY-STATE DT GAS-BLANKET REACTOR. Rijnhuizen Report 75-90. Markvoort, J. A. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Nov 1975. 37p. Dep. NTIS (US Sales Only) $4.00.

A four-fluid model of a cylindrical steady-state DT gas-blanket reactor is analyzed. The four fluids are electrons, deuterium-tritium, helium, and a high-z impurity. In this model the fuel supply, a 50/50 deuterium-tritium mixture, and the ash removal take place by diffusion, while the fusion energy is carried off by heat conduction in addition to neutron radiation and Bremsstrahlung. The radial temperature gradient and an externally applied magnetic field perpendicular to it, give rise to a thermal force (the Nernst effect) which drives a poloidal current. It is this poloidal current together with the applied axial magnetic field that cause the kinetic pressure to be much larger in the center than at the boundary (for example, 100 atm in the center and 10^{-1} atm at the boundary). The behavior of the plasma is described by the multifluid MHD-equations which are numerically solved with the aid of a Runge Kutta method. (auth)

23000 (NP-20786) HYDROGEN AND HELIUM DENSITY PROFILES IN A STEADY-STATE GAS-BLANKET REACTOR. Rijnhuizen Report 75-91. Markvoort, J. A. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Nov 1975. 112p. Dep. NTIS $5.50.

A steady-state DT gas-blanket reactor is analyzed. The behavior of the plasma in the reactor, consisting of electrons, a 50/50 deuterium-tritium mixture, and helium, is described by the multi-fluid MHD-equations. The set of equations differs in one important aspect from the usual ones as the thermoelectric forces arising from both electron-ion and ion-ion collisions are taken into account. The equations are numerically solved with the aid of a Runge-Kutta method. (auth)

23001 (NP-20787) EDDY CURRENTS IN THE ALCATOR TOKAMAK. Rijnhuizen Report 75-88. Schram, D. C.; Rem, J. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Mar 1975. 52p. Dep. NTIS (US Sales Only) $4.50.

A one-dimensional model of an aircore transformer is developed through which it is possible to analyze the effect of eddy currents in the primary windings—and of similar currents in the field coils for the toroidal magnetic field—on the time dependence of the current in a Tokamak experiment. The model is applied to the "Alcator" Tokamak at MIT and its accuracy is tested by comparing analytical results for the harmonic behavior of the transformer, with experimental data. The time-dependent behavior of the plasma current—for a constant plasma resistance—shows that eddy currents in the primary windings will lead to a reduction of 8% of the current maximum. The eddy currents in the "Bitter" coils are found to affect predominantly the initial current rise, they lead to a steepening of the current rise. Finally, the influence of the time dependence of the plasma resistance is investigated. (auth)

23002 (ORNL/TM-5259) LETTER REPORT FOR THE SUPERCONDUCTING MAGNET DEVELOPMENT PROGRAM, SEPTEMBER 1, 1975—DECEMBER 1, 1975. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 14p. Dep. NTIS $4.50.

Brief discussions are given on the following topics: (1) program objectives, (2) implementation of the program, (3) program Staff as of 1 Dec. 1975, (4) subprogram reports, (5) list of major purchases, (6) list of new proposals under consideration, and (7) visitors. (auth)

23003 (UCID-16989) PLASMA FOCUS PROJECT. Sahlin, H. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1975. Contract W-7405-Eng-48. 22p. Dep. NTIS $3.50.

The primary objective of this project is to provide a relatively simple pulsed power source for high density pulsed fusion studies with a variety of DT and other fusion microexplosion targets. The plasma focus operated on DT at 1 MJ should produce greater than or equal to 10^{15} DT neutrons per pulse corresponding to 2800 J of nuclear energy release and for low pressure operation and appropriately configured high Z anode center should yield an x-ray burst of about 1000 J with a substantial fraction of this x-ray energy concentrated in the 5-100 kV range. Because of its x-ray and neutron production potential, the operation of the focus as an x-ray source is also under study and an initial design study for a repetitively pulsed 1 MJ plasma focus as a pulsed neutron materials testing source has been completed. The plasma focus seems particularly appropriate for application as a materials testing source for pulsed fusion reactors, for example, based on laser driven fusion microexplosions. The construction status of the device is described. (MOW)

23004 (UCID-17022) PROGRESS ON THE REFERENCE MIRROR FUSION REACTOR DESIGN. Carlson, G. A.; Doggett, J. N.; Moir, R. W. (California Univ., Livermore (USA). Law-

rence Livermore Lab.). 2 Feb 1976. Contract W-7405-Eng-48. 7p. Dep. NTIS $4.00.

The design of a reference mirror fusion reactor is underway at Lawrence Livermore Laboratory. The reactor, rated at about 900 MWe, features steady-state operation, an absence of plasma impurity problems, and good accessibility for blanket maintenance. It is concluded that a mirror reactor appears workable, but its $/kWe cost will be considerably higher than present-day nuclear costs. The cost would be reduced most markedly by an increase in plasma Q. (auth)

23005 (UCID-17032) WATER-COOLED GRID "WIRES" FOR DIRECT CONVERTERS. Schwer, C. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1976. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

A study was conducted to determine the feasibility of internal convective cooling of grid "wires" for direct converters. Detailed computer calculations reveal that the use of small diameter water-cooled tubes as grid "wires" is feasible for a considerable range of lengths and thermal fluxes. (auth)

23006 (UCRL-51874) ASTRON PROGRAM FINAL REPORT. Briggs, R. J.; Hester, R. E.; Porter, G. D.; Sherwood, W. A.; Spoerlein, R.; Stallard, B. W.; Taska, J.; Weiss, P. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Aug 1975. Contract W-7405-Eng-48. 99p. Dep. NTIS $5.45.

This report describes important experimental results obtained in the last two years of the Astron Program, an LLL controlled nuclear fusion program which terminated in 1973. Little theoretical work is included, but an extensive bibliography is given. (auth)

23007 (UCRL-52000-75-11, pp 7-10) LASERS AND LASER APPLICATIONS. Narrowband Fluorescer Used to Drive an Iodine Photodissociation Laser. Nov 1975.

In energy and technology review. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The high energy and average power eventually required for a laser-fusion power reactor preclude the use of solid-state or liquid lasers as now conceived. A program is under way at LLL to develop short-wavelength, high-efficiency, gas-laser media that have the appropriate physical characteristics for reactor applications. Photolytic lasers pumped by narrowband excimer fluorescence are one possibility. An iodine photodissociation laser using fluorescence from the $XeBr^*$ excimer as a pump source was demonstrated. This scheme is being pursued as a candidate source for future laser-research facilities. (auth)

23008 (UCRL-76714) LAWRENCE LIVERMORE LASER FUSION PROGRAM: A STATUS REPORT. Krupke, W. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1975. Contract W-7405-Eng-48. 37p. (CONF-750460-6). Dep. NTIS $4.00.

From 3rd conference on the laser; New York, New York, USA (22 Apr 1975).

The Laser Fusion Program at the Lawrence Livermore Laboratory is presently emerging from a three-year period of intensive development of the tools required for significant DT implosion experiments of continuously increasing scale. These diverse tools include target design codes, sophisticated target fabrication techniques, radically new diagnostics instrumentation, high peak-power-high brightness laser technology, and fully integrated laser-target-diagnostic irradiation facilities. These tools have recently led to the successful production of neutrons from compressed DT-containing targets together with a wealth of correlating plasma physics data. The current status of major program activities at LLL will be reviewed and major future milestones will be projected. (auth)

23009 (UCRL-76986) OPTIMIZING THE MIRROR (FUSION-FISSION) HYBRID REACTOR FOR PLUTONIUM PRODUCTION. Lee, J. D.; Bender, D. J.; Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1975. Contract W-7405-eng-48. 28p. (CONF-751101-68). Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

An analytic model of the fusion components is used to generate a consistent set of fusion parameters, and component costs as parameters are varied. A model of the blanket, based on neutronic and thermal hydraulics, is then used to analyze the trade-offs of energy production vs plutonium production dictated by blanket type and management. An economic discussion of fuel cost is also given. (MOW)

23010 (UCRL-77043) INTERACTION OF 1.06 mu m LASER LIGHT WITH SPHERICAL TARGETS IMBEDDED IN LOW DENSITY FOAM. Thiessen, A. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1975. Contract W-7405-Eng-48. 16p. (CONF-751130-19). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Computer calculations of the interaction of a 1.06 mu m laser pulse with a spherical DT-filled glass shell embedded in low density foam are compared with experimental results. Poor coupling of the absorbed energy to the spherical capsule was observed, resulting in a barely detectable neutron signal. The x-ray micrograph shows that the electron conduction in the target was strongly inhibited. Calculational results are presented that indicate the inhibited electron conduction may be the result of large spontaneously generated magnetic fields. Calculations including the magnetic field are seen to agree reasonably well with the experiment. (auth)

23011 (UCRL-77050) COMPARISON OF RECENT EXPERIMENTAL RESULTS ON X-RAY EMISSION TO LASNEX CALCULATIONS. Bailey, D. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1975. Contract W-7405-Eng-48. 14p. (CONF-751130-20). Dep. NTIS $3.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Recently NRL reported the results of x-ray measurements from short pulse Nd laser shots on thick polyethylene slab targets with intensities approaching 10^{16} W/cm^2. Results of similar experiments are reported here. NRL data are shown together with data from the LLL series. Calculations of these experiments were made with the LLL LASNEX MHD code. A comparison is given. (MOW)

23012 (UCRL-77216) PELLET TRAJECTORY CORRECTION. Bogdanoff, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 7p. (CONF-751125-138). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The injection of frozen ammonia droplets in the Baseball II magnetic confinement system is discussed. Two ways to correct for random particle trajectories are described: (1) design non-turbulent orifices, and (2) design a trajectory correction system. (MOW)

23013 (UCRL-77799) SURFACE BOMBARDMENT RATES FOR MIRROR FUSION REACTOR DESIGNS. Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1976. Contract W-7405-eng-48. 25p. (CONF-760209-17). Dep. NTIS $3.50.

From 2nd international conference on surface effects in controlled fusion devices; San Francisco, California, United States of America (USA) (16 Feb 1976).

Arrival rates of D^0, T^0, D^+, T^+, He^{++}, neutrons, and photons are given for FERF (Fusion Engineering Research Facility, a mirror confinement reactor dedicated to materials research and to component testing), a hybrid fusion-fission reactor designed primarily to produce fissile fuel, and a D-T power reactor design. For comparison a next-generation confinement-mirror experiment called MX is included. The surfaces of interest are the first wall, the end wall, the direct converter and the injector. (auth)

23014 (UCRL-Trans-10923) ELECTRIC EXPLOSION OF FOILS IN ARC-QUENCHING MEDIA. Burtsev, V. A.; Gudenko, V. V.; Dubovoi, L. V.; Litunovskii, V. N.; Prokopenko, V. F.; Shchekin, Yu. G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Aug 1975. Translation of Russian Preprint T-0224. 18p. Dep. NTIS $4.50.

The results of an experimental study of electrical explosions of foils in solid, liquid, and pulverized media are reported and compared with data obtained by studying foil explosions in air. Electrical explosions of conductors have recently attracted increasing attention in connection with the rapid development of high-current switching gear for high-power supply systems of various electrophysical installations. It is well-known that, in contrast to capacitive energy storage, inductive storage requires the development of circuit-breaking rather than circuit-making gear. The former is technologically much more difficult because of insulation problems during the circuit-breaking process which is accompanied by the appearance of an electric arc. (auth)

23015 (UWFDM-68(Vol. 1)) UWMAK-I: A WISCONSIN TOROIDAL FUSION REACTOR DESIGN. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). 20 Nov 1975. 767p. Univ. of Wisconsin, Madison, WI.

The design details of a low-beta, D-T fusion reactor based on the Tokamak concept is discussed. Various technological problems are discussed. The thermal power output of the plant is 5000 MW. The basic structural material is 316 stainless steel and the heat transfer medium is lithium. Materials compatibility limits the maximum temperature to 500°C implying an electrical output of approximately 1500 MW(e) is to be expected. (MOW)

23016 (UWFDM-112) UWMAK-II: A CONCEPTUAL TOKAMAK REACTOR DESIGN. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Oct 1975. 659p. Univ. of Wisconsin, Madison, WI.

This report describes the conceptual design of a Tokamak fusion power reactor, UWMAK-II. The aim of this study is to perform a self consistent and thorough analysis of a probable future fusion power reactor in order to assess the technological problems posed by such a system and to examine feasible solutions. UWMAK-II is a conceptual Tokamak fusion reactor designed to deliver 1716 MWe continuously and to generate 5000 MW(th) during the plasma burn. The structural material is 316 stainless steel and the primary coolant is helium. UWMAK-II is a low aspect ratio, low field design and includes a double null, axisymmetric poloidal field divertor for impurity control. In addition, a carbon curtain, made of two dimensional woven carbon fiber, is mounted on the first vacuum chamber wall to protect the plasma from high Z impurities and to protect the first wall from erosion by charged particle bombardment. The blanket is designed to minimize the inventory of both tritium and lithium while achieving a breeding ratio greater than one. This has led to a blanket design based on the use of a solid breeding material ($LiAlO_2$) with beryllium as a neutron multiplier. The lithium is enriched to 90 percent ^6Li and the blanket coolant is helium at a maximum pressure of 750 psia (5.2×10^6 N/m^2). A cell of the UWMAK-II blanket design is shown. The breeding ratio is between 1.11 and 1.19 based on one-dimensional discrete ordinates transport calculations, depending on the method of homogenization. Detailed Monte Carlo calculations, which take into account the more complicated geometry, give a breeding ratio of 1.06. The total energy per fusion is 21.56 MeV, which is fairly high. (auth)

23017 SOME NOTES ON LINERS. Linhart, J. G. (EURATOM–CNEN, Frascati, Italy). pp 110-130 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The basic theory for power amplification by the use of liners is given. The propulsion of liners and the use of liners for controlled fusion are described. (MOW)

23018 PLASMA FOCUS AND THERMONUCLEAR FUSION. Maisonnier, C. (EURATOM–CNEN, Frascati, Italy). pp 131-154 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The following topics are discussed: (1) mechanism of neutron emission, (2) analysis of a particular shot, (3) energetic consideration and scaling laws, and (4) extrapolation to larger devices. (MOW)

23019 THETA-PINCH TOROIDAL REACTOR. Ribe, F. L. (Los Alamos Scientific Lab., NM). pp 246-276 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

An engineering conceptual design study is presented of a fusion reactor power plant based on the theta-pinch concept. A high-beta, deuterium-tritium (D – T) plasma is produced by means of a programmed pulsed magnetic field in an approximately toroidal chamber having major and minor radii of 56 and 0.5 meters, respectively. The field produces a short, fast implosion stage followed by a longer adiabatic-compression stage during which the D–T fusion occurs. The D–T burn stage has a duration of approximately 0.080 sec, and the cycle time is 10 sec. To protect the first wall after the burn, a gas blanket is used to cool the plasma in a slowly decreasing magnetic field. The fusion reactor power plant consists of 10 major systems as follows: implosion heating, plasma compression and confinement, magnetic energy transfer and storage, first wall, blanket, biological shield, fuel supply and removal, fuel-ash reprocessing, lithium processing and energy conversion. Liquid lithium is the primary coolant. Other materials include alumina, provisionally chosen as the first-wall insulator, niobium as the first-wall and blanket structural material, beryllium as the neutron breeder, and graphite as a moderator. Two energy conversion schemes are considered: (i) a conventional, low-temperature system which uses a Na-steam cycle, and (ii) an advanced, high-temperature steam system which uses a potassium topping cycle. Special attention is given to plasma burn dynamics, overall energy balance, blanket neutronics and thermal response, radiation shielding, radiation effects on and corrosion of construction materials, thermal and irradiation response of the Al_2O_3Nb first wall, and tritium recovery and containment. (auth)

23020 ELECTRICAL ENGINEERING PROBLEMS IN PULSED MAGNETICALLY CONFINED REACTORS. James, T. E. (Culham Lab., Abingdon, Eng.). pp 297-319 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

Electrical engineering problems are considered for pulsed magnetically confined toroidal fusion reactors. These are based on the Theta-pinch, Reverse-Field Pinch and Tokamak magnetic field configurations. The major problems are concerned with the magnetic field system (eddy current losses and transient forces), pulsed power supplies and associated aspects such as circulating power fraction and economic factors. All systems require the transfer of several 1,000 MJ at high efficiency and with peak power ratings probably more than 5 times the plant electrical output. A solution of this problem may require that the pulsed field energy (MJ) be no more than about 3 times the reactor nuclear power (MW) and transferred in a time > 1.0 s. This condition is most likely to be met in the Reverse Field Pinch and Tokamak systems, since the Theta-pinch proposal is based on a transfer time of 30 ms. Of these two alternatives the Reversed Field Pinch using copper coils appears to be the least complex and cheapest system, because the Tokamak requires additionally a large high field superconducting field system and probably extra plasma heating. (auth)

23021 NEUTRAL GAS LAYER FOR HEAT REMOVAL. Brandt, B. (Commission of the European Communities, Brussels). pp 320-330 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

One hopes to surround a thermonuclear plasma with a gas blanket. Among other advantages the first wall of the reactor would come in contact only with particles of relatively mild temperature. The requirements for the gas blanket are essentially different for a steady state and for a pulsed reactor. Considerations for the RTPR are reviewed. (auth)

23022 CONCEPTUAL DESIGN OF A SERIES OF LASER-FUSION POWER PLANTS OF 100 TO 3000 MW(e). Fraas, A. P. (Oak Ridge National Lab., TN). pp 331-363 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

This paper outlines the design boundary conditions that must be met, presents a conceptual design evolved to meet these boundary conditions following an earlier approach, discussed the design rationale that served as a basis of the design, applies the results of recent analyses and tests, and highlights the principal uncertainties that must be resolved before the conceptual design could be translated into hardware. (MOW)

23023 "SATURN": A CONCEPTUAL DESIGN OF A LASER FUSION POWER PLANT. Foerster, S.; Bohn, F. H.; Conrads, H.; Darvas, J.; Sack, B. (Kernforschungsanlage, Juelich, Ger.). pp 364-414 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

SATURN is a single cavity laser driven fusion reactor power plant where the energy conversion system is directly coupled to the blanket region. The physical background, the design assumptions and the uncertainties concerning the realization of the various new components of the plant are indicated. (MOW)

23024 LECTURE ON THE IMPLOSION EXPERIMENTS AT THE CENTRE D'ETUDES DE LIMEIL. Description of the Set-Up of the Experiment and the Problem of the Targets. Babuel-Peyrissac, J. P. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). pp 415-434 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The following topics are briefly described: (1) the present state of the studies concerning the implosion by laser light at Limeil, (2) beam delivery, (3) target problems, and (4) the cylindrical implosion experiment at Limeil. (MOW)

23025 HIGH BRIGHTNESS LASERS FOR GENERATING HOT AND DENSE PLASMAS. Robieux, J. pp 435-551 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The physical laws that govern the production of high laser energies are discussed. The characteristics achieved with neodymium, CO_2–N, and F_2–H_2 lasers are described. (MOW)

23026 TOPPING AND BOTTOMING CYCLES. Fraas, A. P. (Oak Ridge National Lab., TN). pp 552-571 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

A review is given of the more interesting special thermodynamic cycles and working fluids that have been investigated in recent years in an effort to exploit particular properties for special applications such as gas-cooled reactors and geothermal systems. These cycles are compared briefly with conventional steam plants, and then the development problems and status of the two leading contenders, the gas turbine and potassium vapor topping cycles, are examined in more detail. (auth)

23027 HIGH POWER GAS LASERS FOR FUSION EXPERIMENTS: PRESENT AND FUTURE. Kompa, K. L. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 572-591 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

This seminar deals with three types of lasers that are suitable for the demonstration of laser characteristics with relevance to present and future high power laser developments. The first example is a laser working on an atomic transition, the photochemical iodine laser, the second one is a molecular laser, hydrogen fluoride while the third is the molecular xenon laser to show some of the parameters common to the new class of exciplex lasers. Suggested additional readings are indicated in the attached list of references. (auth)

23028 ENERGY STORAGE AND TRANSFER. Rostagni, G. (Univ., Padua). pp 594-624 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The paper discusses the need of an energy storage device for pulsed fusion reactors. The input energy requirements of a number of reactor schemes presently under study are examined. Different techniques of energy storage and transfer are considered and compared with respect to energy density, power density and basic cost. Overall cost of the storage system is roughly evaluated for the reactors considered. (auth)

23029 THERMOMECHANICAL AND EROSION EFFECTS IN THE FIRST WALL AND BLANKET OF POWER THERMONUCLEAR PULSED REACTORS. Casini, G. (EURATOM, Ispra, Italy). pp 625-650 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

These lectures are devoted to the assessment of the main problems related to the thermomechanical response of the containment wall and blanket of pulsed fusion reactors. Two typical reactors, one magnetically confined (Reference Theta Pinch Reactor) and one laser driven and inertially confined are considered in order to get a comparative view of the main design requirements and operating features. (MOW)

23030 PROBLEMS OF TRITIUM PRODUCTION, RADIATION DAMAGE, AND NEUTRON ACTIVATION IN BLANKETS OF PULSED FUSION REACTORS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 651-681 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The problems of tritium production, radiation damage, and neutron activation cannot be treated in view of the pulsed operation but they have to be seen from the point of the specific blanket design requirements for both θ-pinch and laser fusion reactors. Therefore, at first the main design features of three typical reactor blankets are summarized. After a short description of the principles of tritium breeding some remarks are added concerning the breeding ratios obtained, the tritium recovery methods applied and the implications on the overall tritium economy. In discussing the problems of radiation damage the attempt of a systematic visualization is made showing the complex interdependence of the single damaging effects. By means of this scheme the special problems of structure materials and of insulators are outlined. A further chapter is devoted to the subjects of activation and afterheat production in a niobium blanket. It is recognized that the biological hazard potential of the activated substances is more suitable for an objective judgement of the fusion reactor hazard potential than is the activity itself. (auth)

23031 SYSTEM ANALYSIS OF MAGNETICALLY CONFINED PULSED REACTORS. Koeppendoerfer, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 682-695 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

This paper deals with fusion reactors based on magnetically confined plasmas which are operated by periodic pulses. Pulsed operation is necessary for the following reasons: (1) plasma confinement is limited in time (e.g., decay of plasma currents) (2) the composition of the plasma can not be maintained (e.g., inward diffusion of impurities, refueling and ash removal not accurately possible) (3) the plasma parameters and dimensions chosen lead to too high power in the case of stationary operation (e.g., shock produced high density plasmas). (auth)

23032 SYSTEM ANALYSIS OF INERTIALLY CONFINED REACTORS. Foerster, S. (Kernforschungsanlage, Juelich, Ger.). pp 696-722 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

An approach to analyze a power plant utilizing a laser-fusion reactor is described. The following design areas and performance characteristics are discussed: ignition system, thermodynamic characteristics, design of reactor and of whole plant, economic aspects, and potential of the system. (MOW)

23033 CRITERIA AND METHODS FOR THE COMPARISON OF ALTERNATIVE REACTORS. Hancox, R. (Commission of the European Communities, Brussels). pp 733-746 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

The possible criteria discussed include: physical feasibility, technological feasibility, operational acceptibility, and eventual use. The following methods of comparison were used: parametric studies, conceptual reactor design studies, system studies, and cost-benefit analysis. (MOW)

23034 EVALUATION OF TIMESCALE AND EFFORT. Hancox, R. (Commission of the European Communities, Brussels). pp 747-755 of Pulsed Fusion Reactors. New York; Pergamon Press (1975).

From conference on pulsed fusion reactors; Erice-Trapani, Sicily, Italy (9 Sep 1974). See EUR-5307e; CONF-7409131-.

Some of the intermediate stages in building a prototype fusion reactor are discussed. Some alternate confinement systems are described along with manpower and cost estimates. (MOW)

23035 DOSIMETRY RELATED TO CONTROLLED THERMONUCLEAR RESEARCH. Dudey, N. D. (Argonne National Lab., IL). J. Test. Eval.; 3: No. 3, 238-243(May 1975).

From ASTM minisymposium on neutron dosimetry and spectrum analysis for materials applications; San Diego, CA (3 Dec 1974).

Controlled thermonuclear research (CTR) dosimetry is presently concerned with measurements of neutron flux, fluence, and neutron spectra. This information is being used to (1) correlate radiation effects data, (2) evaluate and describe the irradiation environment of currently available neutron sources, and (3) provide diagnostics for plasma physics studies. Current radiation effects studies are emphasizing surface phenomena such as sputtering, and are utilizing (d,t) and Be(d,n) reactions as the sources of neutrons. The energy region of 8 to 15 MeV is of most interest for CTR purposes. Experimental constraints necessitate use of the foil activation technique for dosimetry measurements. For the cases of monoenergetic neutron sources (RTNS), accuracies of about 7.5 percent are being obtained. Cross section uncertainties are limiting the accuracy for broad spectrum measurements, such as from Be-d sources. Because no present neutron source adequately represents the type of radiation environment expected to be encountered in future CTR devices, emphasis must be placed on carefully documenting and standardizing the dosimetry measurements so that the radiation effects data can ultimately be extrapolated to anticipated CTR conditions. Future efforts in CTR dosimetry must develop methods for characterizing charged and neutral particle radiation. (auth)

23036 NUCLEAR FUSION: ENERGY SOURCE OF THE FUTURE. Knoepfel, H. (Oak Ridge National Lab., Tenn. (USA)). Bull. Schweiz. Elektrotech. Ver.; 66: No. 5, 261-268(8 Mar 1975). (In German)

An outline is given for the nonspecialist, with particular attention to tokamak and containment systems. (auth)

23037 STATE AND DEVELOPMENT TRENDS OF THERMONUCLEAR REACTOR TECHNOLOGY. Seifritz, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 17: No. 1, 1-15(Jan 1975). (In German)

A comprehensive treatment of the potential of fusion as an energy source is presented. In contrast to similar articles of this kind, special emphasis has been focused not so much on plasma-physics problems, but on the technology of first generation fusion reactors. A comparison of the radioactive waste storage problem between a sodium cooled fast breeder reactor and a DT-fusion reactor is discussed. The tritium problem is treated, too. In addition the potential of advanced fusion reactors including laser fusion systems is reviewed. (auth)

23038 INTENSE BEAM HEATING OF AN ORIFICE FLOW. deLeeuw, J.H.; Haasz, A.A.; Stangeby, P.C.; Tong, D.T. (Institute for Aerospace Studies, University of Toronto, Toronto, Ontario M3H 5T6, Canada); Robinson, J.E. Phys. Rev. Lett. 35: No. 26, 1760-1763 (29 Dec 1975).

Experimental results are reported for the first time on orifice flows in which deposited electron-beam energy exceeds flow stagnation enthalpy. The experiment simulates the ion-beam—gas-flow interaction of the gas-target neutron generators planned for fusion engineering research. While gas-dynamic stability is observed, plasma-dynamic-gas-dynamic interactions are found to be important at high power and ionization densities. (auth)

23039 MEASUREMENT OF INTENSE MAGNETIC FIELDS ASSOCIATED WITH LASER—PRODUCED PLASMAS. Serov, R.; Richardson, M.C. (Division of Physics, National Research Council of Canada, Ottawa, Canada). Appl. Phys. Lett. 28: No. 3, 115-118 (1 Feb 1976).

Measurements have been made with subnanosecond resolution of the azimuthal magnetic field spontaneously associated with plasmas produced by high-intensity (10^{12}–10^{14} W/cm^2) 1-nsec-duration CO_2 laser pulses. In addition to a distinct dependence on background argon gas pressure, it is found that the magnetic field displays a $1/r^2$ radial dependence, and its onset is synchronous with the initial formation of the plasma. (auth)

23040 CO_2-LASER-PRODUCED PLASMA COLUMNS IN A SOLENOIDAL MAGNETIC FIELD. Offenberger, A.A.; Cervenan, M.R.; Smy, P.R. (Department of Electrical Engineering, University of Alberta, Edmonton, Alberta, Canada). J. Appl. Phys. 47: No. 2, 494-497 (Feb 1976).

A 1-GW CO_2 laser pulse has been used to produce extended column breakdown of hydrogen at low pressure in a 20-cm-long solenoid. Magnetic fields of up to 110 kG were used to inhibit radial losses of the plasma column. A differential pumping scheme was devised to prevent formation of an opaque absorption wave travelling out of the solenoid back toward the focusing lens. Target burns give direct evidence for trapped laser beam propagation along the plasma column. (auth)

23041 EFFECT OF HIGH MAGNETIC FIELDS ON THE THRESHOLD OF LASER-INDUCED GAS BREAKDOWN. Button, E.J.; Guenther, A.H. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 47: No. 2, 522-530 (Feb 1976).

A quantum rate analysis of laser-induced breakdown in deuterium and helium gas was used to predict the dependence of the breakdown-threshold intensity on gas pressure, laser-pulse length, and the magnitude of an applied external magnetic field parallel to the direction of propagation of the laser beam. Diffusion, elastic and inelastic collisions, and multiphoton ionization of atomic and molecular states excited by electron impact were considered. The threshold data indicate the presence of three distinct regions: the pulse-length dominated, intermediate, and the diffusion dominated, as well as the importance of a dimensionless parameter Ω in determining the magnitude of the magnetic field effect on the breakdown threshold for a given set of experimental conditions. The results are in excellent agreement with experimental data. (auth)

23042 PULSE SHAPE GENERATOR FOR LASER FUSION. Thomas, C.E.; Siebert, L.D. (KMS Fusion, Inc., P.O. Box 1567, Ann Arbor, Michigan 48106). Appl. Opt. 15: No. 2, 462-465 (Feb 1976).

Current laser-fusion theory dictates the need for relatively short laser pulses that are shaped in time to implode optimally a fuel pellet. The laser pulse width and shape should be varied to match different types and sizes of targets. For current experiments, pulse widths as short as 100 psec are desirable, which eliminates the choice of relatively slow electrooptic shutters to shape the pulse, since they are limited to rise times and pulse widths longer than several hundred picoseconds. The device described here can generate a wide variety of pulse shapes and widths by stacking a set of 30-psec mode-locked pulses. This versatile pulse stacker currently shapes the pulses for the KMS Fusion neodymium-doped-glass laser system that has produced over 500 neutron-yielding shots since 1 May 1974 by heating and compressing deuterium or deuterium-tritium fuel inside hollow glass spherical targets. (auth)

23043 EFFECT OF A LONGITUDINAL CURRENT ON THE MAGNETIC CONFIGURATION IN A STELLARATOR. Aleksin, V.F.; Pyatov, V.N.; Sebko, V.P.; Tyupa, V.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Tech. Phys. 20: No. 3, 335-338 (Mar 1975).

It is shown that if the longitudinal current in a plasma has a parabolically decreasing radial distribution it can significantly change the characteristics of an $l=3$ stellarator. The reduction of the shear near rational magnetic surfaces leads to relatively large resonance regions (the resonances $i=\pi$ and $i=2\pi$, where i is the total rotational transform). The reduction of the shear and the appearance of a rosette structure can degrade the containment properties of the stellarator when ohmic heating is used. If the lines of force are "unwound" by the current in the plasma, the appearance of rosettes (resonance $i=0$) is accompanied by a decrease in the rotational transform in the peripheral region. This can increase the neoclassical transport coefficients and degrade the plasma equilibrium in the stellarator. The calculations agree with the experiments obtained on stellarators with a current-carrying plasma. (auth)

23044 REGULAR STRUCTURE IN THE REGION OF THE STREAM COMPRESSION OF A MAGNETOPLASMA COMPRESSOR. Kovrov, P.E.; Morozov, A.I. (I. V. Kurchatov Institute of Atomic Energy). JETP Lett. 22: No. 3, 61-62 (5 Aug 1975).

Small-scale energy structures are observed in a magnetoplasma compressor in the region of maximum density. A possible explanation is offered in this article for the nature of these structures on the basis of the superheat instability. (auth)

23045 NEAR-FIELD MEASUREMENTS OF SUBNANOSECOND-CREATED LASER PLASMAS. Olsen, J. N.; Mendel, C. W. Jr. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 10, 4407-4415(Oct 1975).

The near field of expansion for plasmas created by a 40-psec 1.0 to 1.5-J laser has been probed to measure the electron density and local electric and magnetic fields. Holographic interferometry was used to measure the electron density in the range 10^{17} to 6 x 10^{18} cm^{-3} at delays of 2.5 to 22 nsec. Space-charge electric fields of up to 1900 V/cm were detected by deflection of a fast He^+ ion beam probe as late as 26 nsec after irradiation. Spontaneous magnetic fields of up to 50 G, rising in 10 nsec, were seen 4 mm from the target, decaying rapidly and often reversing at 8 mm. The temperature in the blowoff estimated from the combination of local electric field and electron-density scale length is high compared to predictions based on a peak T/sub e/ equals 160 eV inferred from a multichannel soft x-ray spectral analysis. An anisotropic fast ion group appears in the interferometric density profiles and ejection of approximately 10^9 fast electrons is observed in the electric field measurements. These effects are compared to the early time ion collector signal and nonthermal x-ray spectrum, respectively. (auth)

Wave Phenomena

23046 (AD-721057) HARMONIC GENERATION IN COLD NONUNIFORM PLASMA IN A MAGNETIC FIELD. Blum, F. A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). May 1970. Contract AF-19(628)-5167. 4p. (JA-3725).

Theoretical discussion of harmonic generation in cold bounded nonuniform magnetoplasmas predicts weak even order harmonic generation (compared to odd order) and strong resonances near cyclotron and maximum upper hybrid resonances for small collision frequencies. (auth)

23047 (AD-728652) EXCITATION OF ELECTROSTATIC WAVES IN NON-UNIFORM MAGNETOPLASMAS. Brownell, J. H. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Apr 1971. Contract F33615-67-C-1284. 212p. (SU-IPR-415).

In order to understand the experimentally observed stabilization of a plasma column by high frequency fields, the process of rf plasma excitation and energy absorption is analyzed rigorously. The electric field excited in a nonuniform magnetoplasma slab (with B perpendicular to the density gradient) by an external source is calculated, and the impedance presented by a grid-plasma system is found. Electrostatic waves which propagate across the magnetic field parallel to the density gradient are considered and particular attention is paid to frequencies close to the upper hybrid frequency. An integral equation in wave number space, which is exact within the assumption of neutrality and of low plasma pressure, is derived for the electric field, and it is shown that a variational principle exists for the admittance of the grid-plasma system. In addition, a differential equation for E(K) is found. These two methods take the entire real K-axis into account, and therefore it is possible to formulate a validity criterion for the long wavelength method used in most previous work. (auth)

23048 (LBL-3291) THEORETICAL STUDIES OF SOME NONLINEAR LASER-PLASMA INTERACTIONS. Cohen, B. I.

(California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 15 Aug 1975. Contract W-7405-Eng-48. 214p. Dep. NTIS $7.75.

Thesis.

The nonlinear coupling of intense, monochromatic, electromagnetic radiation with plasma is considered in a number of special cases. The first part of the thesis serves as an introduction to three-wave interactions. A general formulation of the stimulated scattering of transverse waves by longitudinal modes in a warm, unmagnetized, uniform plasma is constructed. A general dispersion relation is derived that describes Raman and Brillouin scattering, modulational instability, and induced Thomson scattering. Raman scattering (the scattering of a photon into another photon and an electron plasma wave) is investigated as a possible plasma heating scheme. Analytic theory complemented by computer simulation is presented describing the nonlinear mode coupling of laser light with small and large amplitude, resonantly excited electron plasma waves. The simulated scattering of a coherent electromagnetic wave by low frequency density perturbations in homogeneous plasma is discussed. A composite picture of the linear dispersion relations for filamentation and Brillouin scattering is constructed. The absolute instability of Brillouin weak and strong coupling by analytic and numerical means is described. (auth)

23049 (MATT-1196) EXPERIMENTAL STUDIES OF LOWER HYBRID WAVE PROPAGATION. Bellan, P.; Porkolab, M. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Jan 1976. Contract E(11-1)-3073. 42p. Dep. NTIS $4.00.

Experimental measurements of the dispersion and damping of externally excited lower hybrid waves are presented. A multiple-ring slow-wave antenna, having 2 pi/k/sub z/ equals 23 cm, is used to excite these waves in the Princeton L3 or L4 linear devices (B equals 0.5 – 2.8 kG uniform to +- 1 percent for 1.6 m, n approximately 10^{10}, T/sub e/ approximately 3-5 eV, T/sub i/ less than or equal to 0.1 eV, He gas, plasma diameter approximately 10 cm). The waves are localized in a spatial wave packet that propagates into the plasma along a conical trajectory which makes a small angle with respect to the confining magnetic field. Measurements of the dependence of wavelength on frequency are in good agreement with the cold plasma dispersion relation. Measured values of the wave damping are in good agreement with Landau damping by the combination of the main body of the electron distribution and a approximately 30 percent high energy (T/sub e/ approximately 15-30 eV) electron tail. (auth)

23050 (MATT-1211) EXCITATION OF FAST WAVES BY SLOW WAVES NEAR THE LOWER-HYBRID FREQUENCY. Berger, R. L.; Chen, L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Feb 1976. Contract E(11-1)-3073. 9p. Dep. NTIS $4.00.

Resonant and non-resonant decays of short wavelength lower hybrid waves into long wave-length whistler waves and ion acoustic waves are considered. It is shown that the dominant coupling to the ion acoustic mode arises from the magnetic force producing a pressure variation along the magnetic field lines. The growth rate and the threshold condition for this decay instability compare favorably with other decay instabilities near the lower-hybrid frequency. (auth)

23051 (ORNL-tr-4075) USE OF THE PERIODIC DECELERATION SYSTEM FOR EXCITING PLASMA WAVES AT FREQUENCIES NEAR THE LOWER HYBRID. Dyachenko, V. V.; Shcherbinin, O. N. 1975. Translation by S. D. Blalock, Jr. of Russian Report No. 494. 14p. Dep. NTIS $3.50.

Some results of calculation of hf field distribution are given for the slow transverse-magnetic waves (E-type) propagating in a cold nonuniform magnetized plasma. The solution for eigenmodes was obtained in a vacuum space between the plasma surface and the corrugated metal wall by using the analytical expression for plasma surface impedance. The calculated curves make it possible to choose properly the parameters of inner walls of plasma installations to satisfy the accessibility criterion for the excited surface wave to the lower hybrid resonance region. (auth)

23052 FORMATION OF PARTICLE BUNCHES IN ION–ION PLASMA UNDER THE INFLUENCE OF AN EXTERNAL ELECTRICAL FIELD. Kozyrev, Yu. N.; Naida, A. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1740-1742 (Oct 1975). (In Russian)

The effect of a steady electrical field on plasma consisting of positive and negative ions with different masses was studied. It was shown that under these conditions particle bunches are formed. The interaction of the bunches inhibits the free acceleration of the ions forming them and leads to a decrease of the plasma current. (tr-auth)

23053 EXCITATION OF CYLINDRICAL ELECTRON BERNSTEIN WAVES BY MODULATED THIN ELECTRON BEAMS. Ohnuma, T.; Shibata, K.; Adachi, S. (Tohoku Univ., Sendai). Radio Sci.; 10: No. 12, 1071-1075(Dec 1975).

When cylindrical electron beams, density modulated at a prescribed repetition frequency (f approximately 3 to 6 MHz), are injected into plasmas along a magnetic field, cylindrical electron Bernstein waves are found to be launched nearly perpendicular to the electron beams. The wave amplitude and frequency are controlled easily. The mechanism of the excitation of cylindrical electron Bernstein waves by electron beams is investigated theoretically to explain the experimental results. (auth)

23054 ABSOLUTE PARAMETRIC EXCITATION BY AN IMPERFECT PUMP OR BY TURBULENCE IN AN INHOMOGENEOUS PLASMA. Laval, G.; Pellat, R.; Pesme, D. (Centre de Physique Théorique de l'Ecole Polytechnique, 91120 Palaiseau, France). Phys. Rev. Lett. 36: No. 4, 192-196 (26 Jan 1976).

Finite-bandwidth effects are investigated by using the random phase approximation. The conditions of validity are checked by solving exactly a particular model. It is found that a finite coherence length for the pump wave can favor the existence of absolute instability. (auth)

23055 BREAKING OF LARGE-AMPLITUDE WAVES AS A RESULT OF RELATIVISTIC ELECTRON-MASS VARIATION. Drake, J.F.; Lee, Y.C.; Nishikawa, K.; Tsintsadze, N.L. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 36: No. 4, 196-200 (26 Jan 1976).

The role of the relativistic electron-mass variation in the evolution of large-amplitude electromagnetic waves near the cutoff and in the generation of plasma waves by linear mode conversion is investigated. Shock formation and subsequent wave breaking along the electric field of the wave will enhance the absorption of the wave by the plasma. (auth)

23056 COHERENT EMISSION FROM A MODULATED BEAM. Abramov, A.V.; Panasyuk, V.S.; Pankratov, S.G.; Samoshenkov, Yu.K.; Sokolov, A.A.; Stepanov, B.M. Sov. Phys.–Tech. Phys. 20: No. 6, 736-740 (June 1975).

A study is made of the coherent electromagnetic radiation of a modulated electron beam scattered in an ionized gas or moving in vacuum. It is shown that the spectral distribution of the intensity has peaks at the modulation frequency and its harmonics. Measurements of the emitted signal are given as a function of the gas density, beam current, and length of the emitting region. The directivity pattern of the radiation is given. (auth)

23057 EXCITATION OF MODES BY AN ELECTRON BEAM IN AN INHOMOGENEOUS PLASMA. Dolgov, A.S. (A. M. Gor'kii State University, Khar'kov). Sov. Phys.–Tech. Phys. 20: No. 6, 751-753 (June 1975).

A theoretical study is made of modes in a one-dimensional system consisting of an electron beam and an inhomogeneous plasma. A general approach to the analysis of modes in the beam–plasma system is considered when the plasma density varies significantly along the beam axis. The case of a linear increase in plasma density is considered. It is shown that modes that do not have analogs in a homogeneous medium can be excited. (auth)

23058 NONLINEAR INTERACTION BETWEEN A RELATIVISTIC LOW-DENSITY BEAM AND ELECTROSTATIC PLASMA MODES. Dolzhenko, O.V.; Zosimov, A.V. (P. N. Lebedev Physics Institute, Moscow). Sov. Phys.–Tech. Phys. 20: No. 6, 754-756 (June 1975).

The nonlinear interaction of a low-density electron beam with a finite-amplitude longitudinal wave in an unbounded plasma is studied for an arbitrary angle between the beam and the direction of propagation of the wave. The dispersion relation is obtained; this relation becomes the linear dispersion relation for infinitesimal amplitudes. The two stream instability of the linear theory disappears at large amplitudes because the beam electrons are trapped in the electrostatic field of the wave. The threshold amplitude for a stationary nonlinear wave is found. (auth)

23059 EXCITATION OF LOW-FREQUENCY SURFACE WAVES BY PARTICLE BEAMS IN A MAGNETIZED, HIGHLY NONISOTHERMAL PLASMA. Kondratenko, A.N.; Kuklin, V.M. (A. M. Gor'kii State University, Khar'kov). Sov. Phys.–Tech. Phys. 20: No. 6, 820-822 (June 1975).

The excitation by particle beams of low-frequency surface waves which propagate at an arbitrary angle with respect to the fixed magnetic field at the boundary of a magnetized, highly nonisothermal plasma, is analyzed. Both superimposed and spatially separate beam and plasma are treated. The growth rates of the low-frequency surface waves are found for the two-stream and cyclotron instabilities. In general, the two-stream instability predominates. (auth)

23060 CONVERSION OF LONGITUDINAL WAVES INTO TRANSVERSE WAVES IN A MAGNETOPLASMA. Novikov, A.A.;

Rabinovich, M.I.; Fainshtein, S.M. (N. I. Lobachevskii State University, Gor'kii). Sov. Phys.—Tech. Phys. 20: No. 6, 829-831 (June 1975).

A study is made of the interaction between a plasma wave and two transverse waves (a helicon and a high-frequency wave) in a magnetoplasma at a frequency close to the boundary of the region of transparency. The boundary problem is solved for a given low-frequency pump field, and the amplitudes of the high-frequency fields are determined. The energy of the plasma wave is completely converted into high-frequency wave energy. Estimates are given for a semiconductor plasma like InSb. (auth)

23061 EXCITATION OF HIGH-FREQUENCY WAVES IN A PLASMA WITH AN ACCELERATING HALL SHEATH. Aref'ev, V.I.; Kirdyashev, K.P. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 20: No. 3, 330-334 (Mar 1975).

Experimental results are described on the excitation of electron plasma waves in a discharge with a short-circuited Hall current. The measured intensities of the high-frequency waves are two to five orders above the thermal level. It is established that the anode sheath plays an important role in the development of the high-frequency instability. For the electron plasma waves an excitation mechanism is proposed which involves the interaction of the Hall current with the slow electrons formed in ionizing collisions. This mechanism for high-frequency excitation is in qualitative agreement with the experimental results. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 23005 and 23193.

23062 (ANL-75-71) ASSESSMENT STUDY OF DEVICES FROM THE GENERATION OF ELECTRICITY FROM STORED HYDROGEN. Ackerman, J. P.; Barghusen, J. J.; Link, L. E. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 34p. Dep. NTIS $5.00.

A study was performed to evaluate alternative methods for the generation of electricity from stored hydrogen. The generation systems considered were low-temperature and high-temperature fuel cells, gas turbines and steam turbines. These systems were evaluated in terms of present-day technology and future (1995) technology. Of primary interest were the costs and efficiencies of the devices, the versatility of the devices toward various types of gaseous feeds, and the likelihood of commercial development. On the basis of these evaluations, recommendations were made describing the areas of technology which should be developed. (auth)

23063 *NONLINEAR OSCILLATIONS IN AN MHD* GENERATOR. Kolesnikov, V.K.; Height, W.D. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 13: No. 3, 544-547 (May 1975).

The stability of a flow of incompressible electrically conducting fluid in a channel is considered for the case in which there is an entropy gradient due to Joule dissipation. The device is a Faraday generator, the Hall parameter is zero, and the electrical conductivity of the medium is an exponential function of the temperature. The solution is found by means of a series expansion with allowance for the A^4 terms, where A^4 is the square of the oscillation amplitude of the dimensionless velocity. Special cases are considered and the effective electrical conductivity of the medium and the effective load factor are calculated. (auth)

23064 INFLUENCE OF THE TRANSVERSE FRINGING EFFECT ON THE CHARACTERISTICS OF A CONDUCTION MHD CHANNEL WITH INHOMOGENEOUS FLOW. Kovalev, L.K.; Nikitin, Yu.M.; Nikitina, I.A.; Tyumin, V.K. (S. Ordzhonikidze Moscow Aviation Institute). High Temp. 13: No. 3, 548-555 (May 1975).

The transverse fringing effect in a rectangular MHD channel is considered with allowance for the nonuniformity of the flow-velocity and flow-conductivity distributions. The Galerkin method is used to find an approximate solution of the two-dimensional problem. The influence of flow inhomogeneity on the local and integral electrical characteristics of the MHD channel is investigated. Expressions are obtained for the average values of electromagnetic force and electric power over a cross section; they may be used in construction of quasi-one-dimensional canonical flows. Calculations are used to illustrate the results of the analytic investigations. (auth)

23065 EXPERIMENTAL STUDY OF HEAT TRANSFER IN THE CHANNEL OF AN OPEN-CYCLE MAGNETOHYDRODYNAMIC GENERATOR. Kirillov, V.V.; Reshetov, E.P.; Semenov, V.D. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 13: No. 3, 573-580 (May 1975).

The results of an experimental investigation into heat transfer in a flow of partly dissociated gas are presented. The investigation was carried out under conditions corresponding to the operation of an open-cycle MHD generator. The experiments were conducted with a flow of plasma comprising combustion products ($T_{emax}=2600°K$) together with potassium or cesium salts as ionizing additive. The experiments embraced the following range of defining criteria $1.3 \cdot 10^4 \leq Re_x \leq 2.4 \cdot 10^6$; $0.55 \leq Pr_g \leq 0.8$; $0.09 \leq h_w/h_e \leq 0.67$. The result interpreted on the basis of the theoretical model considered in [1]. Comparison is drawn with the results of other authors. The influence of a number of factors specific to heat transfer in MHD generators is considered. (auth)

Facilities and Equipment

23066 (CNLM-2597) CANEL PILOT RADIATOR LABORATORY FAILURE AND REPAIR OF LIQUID METAL FURNACE. Marsh, A. R. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 17 May 1960. 62p. Dep. NTIS $4.50.

The CANCEL Pilot Radiator Laboratory is a complex $4,000,000 facility designed specifically for performance and endurance testing of liquid metal-to-air radiators. The facility, completed in 1959, contains the following major pieces of equipment: two 1,000 gpm liquid metal pumps; two 30,000 Btu/hr liquid metal furnaces; one 43,000 cfm compressor and turbine; and one 200 ton test chamber. During shakedown testing cracks were discovered in the stainless steel tubing of one of the two furnaces to a degree which completely precludes the use of this furnace without lengthy and extensive repairs. The nature and cause of these cracks is such as to also cast doubts on the integrity of the second furnace. This problem, its history, causes, alternative methods for repair and associated ramifications are reported. (auth)

23067 (CONF-741040-P2, pp 225-242) INDUSTRIAL ION IMPLANTATION MACHINES. Ryding, G.; Wittkower, A. B. (Extrion Corp., Gloucester, MA). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

In the last few years, the use of small accelerators for ion implantation has been firmly established as an important manufacturing process in the fabrication of microelectronic devices and circuits. Before 1968 the only machines available for implantation were those designed originally for nuclear research, isotope separation, or neutron generation and adapted for implantation purposes. Since then, equipment has evolved to meet the specific needs of commercial applications. Accelerator components showing the most pronounced evolutionary changes are discussed.

23068 (CONF-741040-P2, pp 263-278) ELECTRONIC DEVICE FABRICATION BY ION IMPLANTATION. Morgan, I. H. (Texas Instruments Inc., Dallas). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

The fundamental atomic collision processes implicit in the use of ion implantation result in depth distributions within the target in ion location, radiation damage, and ionization deposition. These properties together with the unique features of implantation as an 'electronic' process are used as a framework to indicate the different ways in which implantation is being used to impact electronic device fabrication. Since the prime volume and economic impact in the electronics industry have been in application to silicon semiconductor devices, examples of MOS and Bipolar structures in discrete and integrated form are reviewed. MOSFET/LSI technology is emphasized, in view of its impact in memory, calculator, and consumer products. Somewhat different attributes of technology importance are illustrated in III-V compounds. Cases for which radiation damage effects are dominant are reviewed for III-V compounds and magnetic and optical devices. Some final comments on amorphous semiconductors are made.

23069 (UCRL-5007-75-1, pp 9) INDUSTRIAL HYGIENE: RESPIRATOR CARTRIDGE EFFICIENCY STUDIES. 15 Aug 1975.

In hazards control progress report No. 50, January–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Recent progress in investigations of respirator cartridge efficiency is reported. The effect of humidity and temperature on cartridge service life are covered. (GHT)

23070 (UCRL-13667) DEVELOPMENT OF A DESIGN BASIS TORNADO AND STRUCTURAL DESIGN CRITERIA FOR LAWRENCE LIVERMORE LABORATORY'S SITE 300. McDonald, J. R.; Minor, J. E.; Mehta, K. C. (McDonald, Mehta and Minor, Consulting Engineers, Lubbock, Tex. (USA)). Nov 1975. 65p. Dep. NTIS $4.50.

For Univ. of California, Livermore.

Criteria are prescribed and guidance is provided for professional personnel who are involved with the evaluation of existing buildings and facilities at Site 300 near Livermore, California, to resist the possible effects of extreme winds and tornadoes. The development of parameters for the effects of tornadoes and extreme winds and guidelines for evaluation and design of structures are presented. The investigations conducted are summarized and the techniques used for arriving at the combined tornado and extreme wind risk model are discussed. The guidelines for structural design methods for calculating pressure distributions on walls and roofs of structures and methods for accommodating impact loads from missiles are also presented. (auth)

23071 THE VARIATION OF IONIZATION WITH AIR/FUEL RATIO FOR A SPARK-IGNITION ENGINE. Clements, R.M. (Department of Physics, University of Victoria, Victoria, British

Columbia, Canada V8W 2Y2); Smy, P.R. J. Appl. Phys. 47: No. 2, 505-509 (Feb 1976).

A negatively biased flush-mounted planar probe operated both in a pulsed and dc mode has been used to measure the ionization density in the plasma generated by combustion in a single-cylinder spark-ignition engine. The ionization was measured as a function of the air/fuel ratio and was found to exhibit a broad peak ($Q \simeq 2$) whose maximum occurs slightly to the rich side of stoichiometric. The peak ionization was calculated from two slightly different models for ion collection to be $\simeq 10^{19}/m^3$. Values of this magnitude appear to be more reasonable than the very high value of $4 \times 10^{21}/m^3$ deduced by Rado using a similar experimental setup. Finally, it is proposed that this type of measurement may be useful to monitor engine performance. (auth)

Lasers

Refer also to abstracts 23025, 24307, and 24324.

23072 (AD-651615) DESIGN, CONSTRUCTION, AND STUDY OF A Q-SWITCHED CO_2-N_2-He GAS LASER. Polant, R. M.; Lloyd, T. H. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1967. 73p. (GE/EE-67A-6). NTIS $6.00.

Thesis.

An electrically driven mechanical Q-switch was placed in a CO_2-N_2-He laser vacuum to eliminate Brewster angle window losses. The resonator length was 179 cm. Laser output was produced at 10.6 μ and 9.6 μ with and without tube cooling. For tube temperatures from 273 to 183°K., laser output at 4.35 μ was found to vary approximately as exp(constant/T to the $\frac{3}{2}$ power). Cooling the laser tube to 77°K. changed the system to a CO laser. When Q-switched, it produced laser oscillation on 73 lines in the vtov-1 bands of the CO X σ^+ ground state for 3 or = v or = 17. Cascading of these transitions with approximately a 1 μs time delay was observed. (auth)

23073 (AD-655213) LASER OSCILLATION ON ELECTRONIC TRANSITIONS IN NEUTRAL N_2 AND CO. Allen, R. B.; Whittaker, T. F.; Dougal, A. A. (Texas Univ., Austin (USA)). 1967. 11p.

An experimental study of laser action in the N_2 Second Positive band system (C(3)Pi-u to B(3)Pi-g), the N_2 First Positive band system (B(3)Pi-g to A(3)σ-u$^+$), and the CO Angstrom band system (B(1)σ^+ to A(1)π) was made. Conventional, coaxial, and crossed-field laser discharge tube geometries were used. The effect of various rare gas mixtures on the N_2 and CO laser output was investigated and experimental results are presented. (auth)

23074 (AD-708664) CHEMICAL LASER ACTION IN ELECTRICALLY PULSED FLOWING CS_2-O_2 MIXTURES. Arnold, S. J.; Kimbell, G. H. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). 10 Oct 1969. 4p.

Laser action was achieved in spark-excited CS_2-O_2 mixtures at pressures of the order of 1 mm. The laser emission, in the region 5.0 to 5.3 μ, is attributed to CO, a product of combustion. It is suggested that the mechanism responsible for forming the excited CO is Cs + O_2 = CO + SO. (auth)

23075 (AD-711614) STUDY OF ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Technical Report No. 2, 26 April–31 July 1970. Glass, A. J. (Wayne State Univ., Detroit, Mich. (USA)). 31 Jul 1970. Contract DAHC04-70-C-0022. 7p. NTIS $3.00.

A brief summary is presented on the following research: close coupling codes for the calculation of cross sections of interest to the molecular lasers N_2, N_2O, CO_2, and CO; extension of an existing computer program for the vibrational population distribution of a binary mixture of gases to include excitation and de-excitation processes specific to laser mixtures; application of the spectroscopic observation of side light and small signal gain measurements to the determination of vibrational and rotational population distributions in the molecular laser systems under study (initially CO_2 and CO); and preliminary computer modeling of the laser system, including the effects of spatial variation of electron density and temperature and gas temperature. (auth)

23076 (AD-712564) FINAL REPORT ON CONTRACT PO-9-0203. Report for June 1969–June 1970. Kan, T. (Naval Research Lab., Washington, D. C. (USA)). Sep 1970. 4p. NTIS $3.00.

Research on the following topics is very briefly summarized: DF-CO_2 DF-CO_2 vibrational transfer chemical lasers; CS_2-O, CO chemical lasers; the efficiency of electrode configurations for discharge excitation lasers; and the rate of deactivation of CO_2(001). (NTIS)

23077 (AD-716377) CONTINUOUS-WAVE STIMULATED EMISSION IN FLOWING CARBON DISULFIDE-OXYGEN MIXTURES. Suart, R. D.; Kimbell, G. H.; Arnold, S. J. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). 8 Apr 1970. 3p.

In Chem. Phys. Lett.; 5: No. 8, 519-520(1 Jun 1970).

Continuous-wave stimulated emission was observed from vibrationally excited carbon monoxide molecules produced when carbon disulfide is mixed in a laser cavity with oxygen atoms generated in a microwave discharge. (auth)

23078 (AD-717089) STUDY OF ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Quarterly Technical Report No. 3, 31 July–31 October 1970. Glass, A. J. (Wayne State Univ., Detroit, Mich. (USA)). 31 Oct 1970. Contract DAHC04-70-C-0022. 17p. NTIS $3.00.

Briefly discussed is research concerned with the following topics: application of currently available close coupling codes to the calculation of cross sections of interest to the molecular lasers under consideration (initially N_2, N_2O, CO_2, and CO); extension of the existing computer program for the vibrational population distribution of a binary mixture of gases to include excitation and de-excitation processes specific to the laser mixtures of interest; application of the spectroscopic observation of side light and small signal gain measurements to the determination of vibrational and rotational population distributions in the molecular laser systems under study (initially CO_2 and CO); and preliminary computer modeling of the laser system, to include the effects of spatial variation of electron density and temperature and gas temperature. (auth)

23079 (AD-718443) CARBON MONOXIDE LASER. Semi-annual Technical Report, 1 August 1970–January 1971. Bhaumik, M. L. (Northrop Corporate Labs., Hawthorne, Calif. (USA)). 31 Jan 1971. Contract N00014-71-C-0037. 6p. (NCL-71-8R). $3.00.

The small signal gain coefficient and spectral characteristics of an electrically excited room-temperature CO laser were investigated for the purpose of understanding the role of the necessary gas constituents and the possible excitation mechanisms are discussed. (auth)

23080 (AD-728054) STUDY OF ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Final Technical Report, 25 January 1970–31 March 1971. Glass, A. J.; Fisher, E. R.; Kummler, R. H.; Marriott, R. (Wayne State Univ., Detroit, Mich. (USA)). 31 May 1971. Contract DAHC04-70-C-0022. 118p. NTIS $3.00.

The carbon monoxide laser is one of the most promising systems currently available for the efficient generation of infrared radiation in the wavelength region from 5 to 8 μ. A detailed model of the kinetic processes which govern the performance of this laser has been programmed for the IBM 360/67 computer. The temporal development of vibrational populations has been computed and shown to converge to steady state solution generated elsewhere from algebraic computation. A careful investigation of scattering data shows an apparent discrepancy in the potential used to describe the interaction of the CO molecule with argon atoms. An experimental facility has been developed for observation of spontaneous emission from various molecular transitions in the CO laser. (auth)

23081 (AD-729235) KINETIC MODEL AND THEORETICAL CALCULATIONS FOR STEADY STATE ANALYSIS OF ELECTRICALLY EXCITED CO LASER AMPLIFIER SYSTEM. Final Report, Part 2, 1 August 1970–31 July 1971. Lacina, W. B. (Northrop Corporate Labs., Hawthorne, Calif. (USA)). Aug 1971. 115p. (NCL-71-32R). NTIS $3.00.

A qualitative and quantitative discussion of several aspects of electrically excited CO laser systems is presented. Topics included are molecular spectroscopy and radiative properties, molecular kinetics, and plasma characteristics. Special emphasis is on description of a steady state molecular kinetic model which has been constructed for calculation of the vibrational population distributions and resulting radiative properties for a CO laser amplifier system. The master equation for the vibrational populations is formulated, with several pumping, relaxation, cross-relaxation, and stimulated emission processes included. A computer program for cw operation with an arbitrary number of vibrational levels has been constructed for numerical solution of the master equation, and preliminary results for a variety of parameters are presented. The importance of plasma characteristics is discussed, although calculations for the electron kinetics have not yet been undertaken. Future efforts should be made to analyze the coupled system of electron and molecular kinetics on a consistent and equal basis. (auth)

23082 (AD-729257) CARBON MONOXIDE LASER STUDIES. Final Report, Part 1, 1 August 1970–31 July 1971. Bhaumik, M. L. (Northrop Corporate Labs., Hawthorne, Calif. (USA)). Aug 1971. Contract N00014-71-C-0037. 57p. (NCL-71-31R). NTIS $3.00.

In an experimental and analytical study of CO lasers, the characteristics of the laser were determined and the dominant mechanisms identified. The study shows that in an electrically excited CO laser the population inversion occurs due to pumping of the lower vibrational levels by electron impact followed by an harmonic pumping to the upper lasing levels. Overall efficiencies up to 47% have been achieved at 77°K. The small signal gains of the various vibrational rotational lines were measured. The populations of the lasing level were determined from these measurements and the saturation parameter was estimated from the gain measurements. (auth)

23083 (AD-729613) SEALED-OFF OPERATION OF STABLE CO LASERS. Freed, C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 5 Apr 1971. Contract AF19(628)-5167. 5p. (JA-3875). NTIS.

In Appl. Phys. Lett.; 18: No. 10, 458-461(15 May 1971).

Preliminary experiments with completely sealed-off CO lasers are presented. After hundreds of hours of consistently stable and reproducible operation, all evidence indicates that sealed-off CO lasers will have useful lifetimes at least comparable to those of CO_2 lasers. (auth)

23084 (AD-731601) RECENT STUDIES OF THE CS_2/O_2 COMBUSTION LASER. Kimbell, G. H.; Jacobson, T. V.; Suart, R. D.; Arnold, S. J.; Foster, K. D. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). 1971. 9p.

In Mod. Optical Methods in Gas Dynamic Research; 279-287 (1971).

The addition of gases such as N_2, N_2O and He were found to have a dramatic effect in changing the performance of both an electrically sparked and a cw laser. Both the output power and spectroscopic output were monitored in the presence of given amounts of diluent gas as a function of fuel/oxygen ratio. While the pumping reaction in the pulsed operation is felt to be $O + CS \rightarrow CO + S$ no unequivocal evidence can be found to rule out the competing reaction $CS + O_2 \rightarrow CS + SO$ in the cw flow laser. (auth)

23085 (AD-734170) STUDY OF MOLECULAR LASERS. Annual Report. Auer, P. L.; Wolga, G. J. (Cornell Univ., Ithaca, N. Y. (USA)). 1 Nov 1971. Contract N00014-67-A-0077-0006. 105p. NTIS $3.00.

Results from research on molecular and chemical lasers are presented. The topics include: vibrational deexcitation and energy transfer in the HF, CF, HF-CO_2 and DF-CO_2 chemical lasers; shock tube studies of vibrational relaxation in CO_2 induced by collisions; efficient atom production by molecular dissociation in a high power S-band microwave discharge; chemical laser studies with $C_2H_2 + O$, $CS_2 + O$; chemical reaction rates for $H + Cl_2$ to $HCl + Cl$, $H + F_2$ to $HF + F$, $NO + F_2$ to $NOF + F$; study of rapid gas mixing in a subsonic gas flow enhanced by controlled turbulence; and high pressure vibrational relaxation studies in CO_2. (NTIS)

23086 (AD-735869) RESEARCH AND DEVELOPMENT PROGRAMS. Quarterly Progress Report, 1 January–31 March 1971. Noyes, C. F.; Walker, R. E.; Pirkle, J. C.; Frazer, R. K.; Rubinstein, N. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). 31 Mar 1971. Contract N00017-62-C-0604. 40p. NTIS $3.00.

Results are reported on work in the following categories: Microelectronics Laboratory status and improvements; fast flow chemical laser experiment; chemical laser systems, analysis; limitations of current radomes; vibration studies; calorimeter and transpiration cooling free-jet tests; digital control of a missile seeker head; airbreathing propulsion studies which include supersonic combustion analysis and flowfield determination for engine testing; a wideband array antenna system; scram jet propulsion research; meteorological applications of a bidirectional thermistor mass flow sensor; activities of the Environmental Test Laboratory; and energy storage in fiber-composite bar flywheels. (auth)

23087 (AD-736434) EFFECT OF O_2 ON THE CO LASER PERFORMANCE. Report for January–December 1970. Hartwick, T. S.; Walder, J. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Dec 1971. Contract F04701-71-C-0172. 13p. (TR-0172(9230-10)-8). NTIS $3.00.

As the O_2 concentration is increased from zero, the CO laser output power rises to a maximum and declines. This variation is correlated to a decrease in gas discharge kinetic temperature to a minimum followed by an increase for the same variation in O_2 concentration. (auth)

23088 (AD-737710) INFRA-RED LASERS AND INFRA-RED SPECTRA OF FREE RADICALS. Annual Report. Powell, F. X. (Catholic Univ. of America, Washington, D. C. (USA). Dept. of Chemistry). 1971. Contract N00014-67-A-0377-0010. 10p. NTIS $3.00.

Briefly summarized is research concerning the achievement of cw laser action in various atom-molecule reactions, in particular HCl and CO lasers. The methods which were to be employed were detailed in the original proposal and comprised a high power magnetic induction discharge for the generation of atoms and a high speed flow system where these atoms were to be titrated by stable adducts. The initial series of experiments are reported. (auth)

23089 (AD-736928) MODELING OF A PULSED CO/N_2 MOLECULAR LASER SYSTEM. Abraham, G.; Fisher, E. R. (Wayne State Univ., Detroit, Mich. (USA). Research Inst. for Engineering Sciences). Oct 1971. 46p. NTIS $3.00.

A detailed numerical model was developed for characterizing the important energy transfer processes operative in the CO/N_2 direct current discharge laser system. The model is based upon a rate equation formulation which includes 30 levels of both CO and N_2 and treats multi-quantum electron-molecule excitation processes, single quantum vibration-vibration exchange and vibration-translation energy transfer processes and both harmonic and overtone spontaneous emission terms. The time evolution of the CO vibrational distributions with and without N_2 is calculated and the associated small signal gain is predicted and compared to the measurements of Jeffers and Wiswall. (auth)

23090 (AD-740767) CARBON MONOXIDE LASER. Quarterly Technical Status Report. Center, R. E. (Avco-Everett Research Lab., Everett, Mass. (USA)). Apr 1972. Contract N00014-72-C-0030. 16p. NTIS $3.00.

The main objective of this program is the investigation of pulsed electrical CO lasers to determine their potential scaling to large scale, high power operation. The program is based on the application of the electron beam ionizer-sustainer concept to the vibrational excitation of CO with temperature controlled operation. (NTIS)

23091 (AD-742101) VIBRATIONAL RELAXATION OF CO_2 IN EXPANDING FLOWS. Final Technical Report, 1 May 1967–31 December 1971. Russo, A. L. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y. (USA)). Jan 1972. Contract N00014-67-C-0339. 56p. (CAL-RM-2430-A-1). NTIS $3.00.

Vibrational relaxation of CO_2 with Ar, N_2, and CO and the vibrational relaxation of pure CO have been studied in shock-tube driven, quasi-steady supersonic expansion flows in a two-dimensional wedge nozzle. The experiments were conducted over a range of reservoir temperatures of about 2500 to about 4000°K and at a reservoir pressure of about 20 atm. The diagnostic technique was based on quantitative measurements of infrared radiation from CO_2 and the CO fundamental vibration-rotation band. The results indicate that the vibrational relaxation of CO(v3) in the expansion flows proceeds at a rate nearly that obtained from shock wave studies. The efficiency of argon in deexciting CO_2 vibration is estimated. CO is found to relax, vibrationally about two orders of magnitude faster than anticipated on the basis of shock-wave results. The results of CO/CO_2 mixtures indicate strong coupling of the vibrational deexcitation of these species. (auth)

23092 (AD-744890) MEASUREMENT OF THE GAIN LINE SHAPE OF A GAS LASER USING A TUNABLE SEMICONDUCTOR LASER. Blum, F. A.; Nill, K. W.; Calawa, A. R.; Harman, T. C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Jan 1972. Contract F19628-70-C-0230. 4p. (JA-4015). NTIS.

Using a cw tunable PbS (0.6)Se(0.4) semiconductor diode laser operating near 5.3 μ, the gain (loss) line shape of several vibration-rotation lines of a CO gas laser amplifier is fully resolved. (auth)

23093 (AD-745368) STUDY OF ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Interim Technical Report. Glass, A. J. (Wayne State Univ., Detroit, Mich. (USA)). 31 May 1972. Contract DA-ARO-D-31-124-71-G82. 4p. NTIS $3.00.

A study of energy transfer processes in molecular lasers is being carried out. The document is an interim report on progress to date accomplished under this grant. (NTIS)

23094 (AD-746148) ELECTRICAL HIGH-PRESSURE MOLECULAR GAS LASERS. Seppi, E. J. (Institute for Defense Analyses, Arlington, Va. (USA)). May 1972. Contract DAHC15-67-C-0011. 50p. (P-847). NTIS $3.00.

The design and operation of high-power, electrically excited gas lasers are discussed with particular attention given to mo-

lecular-type lasers operating at high pressure. A survey is presented of gases in which laser action has been initiated by electrical discharge at high gas pressure. The basic processes for operation of the carbon-dioxide and carbon-monoxide lasers are described. The design criteria and the potential for high power and high brightness from a carbon-dioxide laser are discussed. The engineering requirements for a pumping arrangement which uses an electron beam for preionization to obtain uniform electric pumping are reviewed. (auth)

23095 (AD-746199) CO (v = 2:1) LASER TRANSITIONS FROM He-AIR-CH_4. Barry, J. D.; Boney, W. E.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 13 May 1971. 3p. (AFAL-TR-71-195). NTIS.

In IEEE J. Quan. Electron.; QE7: No. 9, 461-462(Sep 1971).

A flowing electrochemically excited liquid-nitrogen-cooled He-air-CH_4-(CO) laser was operated in Q-switched fashion yielding 20 CO laser lines below 5.0 micrometers. These laser lines were measured to occur from 4.7848 to 4.9880 micrometers. The lines were all identified to result from P(J)v,v' CO vibrational-rotational transitions as low as v = 2:1. Nine such v = 2:1 transitions were measured. (auth)

23096 (AD-746200) SMALL SIGNAL GAIN IN THE CO-AIR-He LASER. Havey, M. E.; Barry, J. D. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 7 Apr 1971. 4p. (AFAL-TR-71-196). NTIS.

In IEEE J. Quan. Electron.; QE7: No. 7, 370-372(Jul 1971).

The small-signal single-pass gain for 24 individual CO laser lines has been measured for a flowing CO-air-He laser. The vibrational-rotational P(J)v,v' lines considered were for rotational transitions from J = 10 to 16 and upper vibrational levels from v = 7 to 11. The maximum gain was observed for the P(15) 10,9 laser line, with an average logarithmic energy gain of 0.002633/cm. (auth)

23097 (AD-746201) LASER EMISSION FROM He-AIR-C_2N_2-(CO). Barry, J. D.; Boney, W. E.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). Sep 1971. 3p. (AFAL-TR-71-221). NTIS.

In Appl. Phys. Lett.; 19: No. 5, 141-142(1 Sep 1971).

Laser emission from a He-air-C_2N_2-CO mixture was measured in air from 5.0416 to 5.7566 μ. The P(J)v, v' transitions in CO occurred from v = 5:4 to v = 15:14 with J = 9-17 nominally. Multiline power levels exceeded 2 W with over 2% efficiency. The CO molecules were produced by the discharge initiated chemical process $C_2N_2 + O_2 = 2CO + N_2$. (auth)

23098 (AD-746202) CO LASER ACTION BY C_2H_2 OXIDATION. Barry, J. D.; Boney, W. E.; Brandelik, J. E.; Mulder, D. M.; Woessner, J. K. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 20 Dec 1971. 3p. (AFAL-TR-72-73). NTIS.

In Appl. Phys. Lett.; 20: No. 7, 243-244(1 Apr 1972).

Laser emission has been detected from CO molecules produced by the dc discharge-initiated chemical oxidation of C_2H_2. The vibrational-rotational transitions were P branch from v = 3:2 to v = 11:10 with J = 11-14, nominally. The explosive property of the oxidation reaction was verified. (auth)

23099 (AD-748178) ARPA-NRL LASER PROGRAM. Semiannual Technical Report, 1 July–30 December 1971. (Naval Research Lab., Washington, D. C. (USA)). Aug 1972. 38p. (NRL-MR-2483). NTIS $3.00.

The ARPA-NRL high energy laser program is concerned with the development of laser technology in four program areas: chemical lasers, electric discharge lasers; high power glass lasers; and new laser techniques. Progress made in those areas during the first half of FY 72 is summarized. (auth)

23100 (AD-748470) TURBULENT IONIZATION WAVES IN CO AND CO MIXTURES. Bletzinger, P.; Garscadden, A. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Sep 1971. 5p. (ARL-71-0230). NTIS $3.00.

From 10th international conference on phenomena in ionized gases; Oxford, England (1971).

Measurements are reported on the dispersion characteristics of plasma instabilities in a carbon monoxide plasma. Using correlation methods, it was determined that the instabilities are cathode to anode directed forward waves, with little dispersion but broad bandwidth. It is suggested that the entrainment of the noise by an external source, at as high a frequency as possible, can be useful to reduce the influence of discharge fluctuations on the CO laser output. (auth)

23101 (AD-748902) STUDY OF ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Glass, A. J. (Wayne State Univ., Detroit, Mich. (USA)). 31 May 1972. 4p. NTIS $3.00.

A study of energy transfer processes in molecular lasers was carried out. The main effort to date has been in modeling the kinetics of the CO-N_2 molecular laser. An extensive computer model was devised, which can model the behavior of a mixture of two diatomic molecular gases, such as N_2 and CO, along with an added monatomic diluent, such as He, and electrons. Up to 30 vibrational levels are separately accounted for in each of the diatomic constituents. (NTIS)

23102 (AD-751858) CS_2/O_2 CHEMICAL LASERS: CHEMISTRY AND PERFORMANCE CHARACTERISTICS. Suart, R. D.; Dawson, P. H.; Kimbell, G. H. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). 20 Sep 1971. 12p. NTIS.

In J. Appl. Phys.; 43: No. 3, 1022-1032(Mar 1972).

Experimental results from the CS_2/O_2 chemical laser system using both a flash photolysis initiated pulsed laser and a microwave discharge initiated continuous-wave laser were examined by computer simulation techniques. The comparisons between predicted and observed laser performance led to some conclusions concerning the chemical mechanisms operative in the laser. In particular, the laser pumping step is O + CS to CO* + S followed by the chain carrying step S + O_2 to SO + O which must be rapid. The oxygen atom consuming reaction, O + NO_2 to NO + O_2, competes too strongly with the other reaction steps for the photolysis of NO_2 to be effective as a power improving technique in the flash photolysis laser. The cw laser operates on totally inverted vibrational level populations when cold CO is added to the reaction mixture. Some evidence was found to suggest that excess O_2 molecules may act as a vibrational energy sink in the cw system. (auth)

23103 (AD-752818) CARBON MONOXIDE LASER. Semiannual Technical Report, 1 November 1971–30 December 1972. Center, R. E. (Avco-Everett Research Lab., Everett, Mass. (USA)). Jul 1972. Contract N00014-72-C-0030. 20p. NTIS $3.00.

The main objective of the program was the investigation of pulsed electrical CO lasers to determine their potential scaling to large scale, high power operation. The following areas of investigation are included: investigation of the electron beam current requirements and the E/p range for sustainer discharge excitation of CO and CO/N_2 mixtures; design and construction of the electron gun and laser cavity for operation at gas temperatures from 100 to 300°K; experimental investigation of the multiline/multimode operation over a range of gas temperature and pressure up to the equivalent of one atmosphere at room temperature; and the extension of the theoretical model to the directly excited CO laser including calculations of the transient gain and power. (NTIS)

23104 (AD-753308) FEASIBILITY OF PRODUCING LASER PLASMAS VIA PHOTOIONIZATION. Javan, A.; Levine, J. S. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 21 Jun 1972. Contract F19628-73-C-0002. 7p. (JA-4041). NTIS.

In J. Quan. Electron.; QE-8: No. 11, 827-832(Nov 1972).

The production of uniform large-volume laser plasmas with electron-ion densities on the order of 10^{12}/cc or larger by means of photoionization was investigated. An externally applied electric field heats the electron gas to the optimal temperature for excitation of laser levels. Photoionization by intense uv light may take place in a low partial pressure gas of low ionization potential species dispersed throughout the host laser medium, or the laser medium itself may serve as the photoionized species. Both single-photon ionization and two-photon two-step ionization are shown to be applicable. (auth)

23105 (AD-753559) ACADEMY OF SCIENCES OF THE USSR, PHYSICS INSTITUTE. Transactions, Numbers 33, 67, 1972 (selected articles). Sobolev, N. N.; Sokovikov, V. V. Translated from Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR; No. 67, 33, 1-61, 1-63(1972). 91p. (FTD-MT-24-1459-72). NTIS $6.75.

A survey of the investigations of a mechanism for the formation of an inverse population of oscillatory levels in the gas-discharge CO lasers is presented. A major discussion concerns a presentation of the presently available theoretical and experimental data on the probabilities of oscillatory transitions in molecules. Works are discussed in detail in which calculations of the population of oscillatory levels in a CO laser are given. Analysis of the indicated works leads to the conclusion about the correctness of the hypothesis in accordance with which the pumping of energy into the oscillatory degrees of freedom of molecules of CO occurs by electron impact and the population of the high-lying levels. (NTIS)

23106 (AD-754410) ARPA-NRL LASER PROGRAM. Semiannual Technical Report, 1 January–31 July 1972. (Naval Re-

search Lab., Washington, D. C. (USA)). Nov 1972. 159p. (NRL-MR-2529). NTIS $3.00.

The ARPA-NRL high energy laser program is concerned with the development of laser technology in four program areas; chemical lasers, electric discharge lasers; high power glass lasers and new laser techniques. The report summarizes the progress made in those areas during the last half of FY 72. (auth)

23107 (AD-754876) LASER EMISSION FROM He-AIR-CH_4 AND He-AIR-C_3H_8 MIXTURES. Barry, J. D.; Boney, W. E.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 23 Oct 1970. 2p. (AFAL-TR-71-192). NTIS.

In Appl. Phys. Lett.; 18: No. 1, 15-16(1 Jan 1971).

Laser emission from a He-air-CH_4 mixture has been observed from 4.9668 to 5.5056 μ. Most of the cw laser emissions have been identified to result from P(J) vibrational-rotational transitions in CO. Multiline power levels of over 1 W were achieved with the CH_4 mixture. The lasing molecules are apparently formed by chemical-collisional processes within the discharge. Similar cw laser emissions from 4.9467 to 5.5717 μ were observed from a He-air-C_3H_8 mixture. (auth)

23108 (AD-755197) MODELING OF A PULSED CO/N_2 MOLECULAR LASER SYSTEM. Part II. Effect of Mixture Components and Temperature Variation. Fisher, E. R. (Wayne State Univ., Detroit, Mich. (USA). Research Inst. for Engineering Sciences). Nov 1972. 27p. NTIS $3.00.

The CO molecular laser model described in a previous publication has been used to investigate the effect of molecular mixture components and kinetic temperature variations on improving the gain of low lying CO infrared transitions. Gas mixtures involving diatomic molecules with both larger and smaller vibrational level spacing than CO were investigated. Vibrational pumping of CO by a molecule having smaller vibrational spacing lead to negligible laser gain predictions due to the nonspecific nature of vibrational exchange processes. The largest predicted gain in the low lying transitions of CO was found for N_2/CO mixtures at 77°K in which appreciable gain in the 2-1 transition was found. (auth)

23109 (AD-757755) CHARACTERISTICS OF A CO LASER. Bhaumik, M. L.; Lacina, W. N.; Mann, M. M. (Northrop Corp., Hawthorne, Calif. (USA). Laser Systems Dept.). Nov 1971. Contract N00014-71-C-0037. 42p. (NLSD-71-2R). NTIS $3.00.

Some characteristics of CO laser operation are reported. A discussion of the roles of the various ingredients necessary for optimization of the gas compositions is given, and measurements of efficiency, spectral output, small signal gains, and saturation intensity at various temperatures are reported. Important mechanisms which dominate the kinetics of the molecules and electrons in electrical discharge systems are described briefly. Several experimental observations are presented to support the interpretations and conclusions that have been drawn regarding the pumping processes and optimum operating characteristics. The possibility of high power operation of the CO laser with high efficiency is demonstrated by the attainment of laser efficiencies up to 47% with small signal gain coefficients of nearly 0.5%/cm and a saturation intensity of 15 W/cm^2 at a gas temperature of 200°K. (auth)

23110 (AD-758774) DESIGNS AND EXPERIMENTS RELATING TO STABLE GAS LASERS. Freed, C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1 Mar 1973. Contract F19628-73-C-0002. 36p. (TN-1973-14). NTIS $3.00.

Some of the advances in the design and performance of stable gas lasers are described. The construction and output characteristics of highly reproducible, stable, selectable single transition grating-controlled CO_2 and CO lasers are described. Experiments on short-term stability, standing wave saturation resonances, pressure and power broadening, pressure shift, and long-term stabilization of CO_2 lasers are discussed. (auth)

23111 (AD-758943) LAMB DIP IN CO LASERS. Freed, C.; Uaus, H. A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 3 Aug 1972. Contract F19628-73-C-0002. 9p. (JA-4079). NTIS.

In J. Quan. Electron.; QE-9: No. 2, 219-226(Feb 1973).

Measurements are reported of the Lamb dip on 16 vibrational-rotational lines of low-pressure CO lasers. The experimental curves are fitted to a theory that takes into account velocity-changing collisions of the lasing molecules. The inhomogeneous and homogeneous linewidths, velocity-changing collision rate, and saturation intensities are determined for a gas mixture typical in sealed-off CO lasers. (auth)

23112 (AD-759237) MEASUREMENT OF VIBRATIONAL TEMPERATURE IN A CO LASER. Mikaberidze, A. A.; Ochkin, V. N.; Sobolev, N. N. Translated from Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR; No. 54, 1-24(1972). 22p. (FTD-MT-24-1726-72). NTIS $3.25.

The possibility of obtaining high powers in the spectrum region of 5 to 6 μ with CO molecules causes interest in research on the mechanism for creation of an inversion in a CO laser. The vibrational temperatures were determined by the method of the inversion of spectral lines in the infrared region of the spectrum which automatically considers reabsorption and does not require the resolution of the vibrational-rotational spectrum. (NTIS)

23113 (AD-759509) MODELING OF CO/N_2 MOLECULAR LASER SYSTEMS. Semiannual Technical Report, 30 June 1970–25 January 1973. Fisher, E. R.; Lightman, A.; Marriott, R. (Wayne State Univ., Detroit, Mich. (USA). Research Inst. for Engineering Sciences). 6 Feb 1973. 33p. NTIS $3.00.

Over the past three years an extensive molecular laser modeling code has been developed. This model characterizes the time evolution of pulsed molecular laser systems including the effects of non-Boltzmann electron distributions, stimulated emission processes, temperature and density transients and state-of-the-art energy transfer rate coefficients. During the last year a laboratory effort has been developed to complement these analytic studies. Results obtained from the modeling studies and the current status of the laboratory effort are reported. (auth)

23114 (AD-759679) CO-LASER. The Formation Mechanism of Population Inversion. Sobolev, N. N.; Sokovikov, V. V. Translated from Tr. Inst. Fiz. Zemli, Akad. Nauk SSSR; 67: 1-61 (1972). 47p. (FTD-MT-24-1733-72). NTIS $4.50.

The article investigates the formation mechanism of vibrational level population inversion in gas-discharge CO-lasers operating at room temperature and at the temperature of liquid nitrogen. Considerable space is allotted to an exposition of the presently available theoretical and experimental data on the probabilities of vibrational transitions in molecules. The works, in which calculations of the populations of vibrational levels in the CO-laser were carried out, are discussed in detail. (auth)

23115 (AD-759755) CARBON MONOXIDE LASER. Final Technical Report on Phase 1. Center, R. E. (Avco-Everett Research Lab., Everett, Mass. (USA)). Apr 1973. Contract N00014-72-C-0030. 30p. NTIS $3.00.

The development of a 20 liter cooled CO laser designed for pulsed operation with pressures up to 1 atm is described. An electron beam sustained discharge is used for the gas excitation. Pulsed output energies up to 1 kJ observed and the results are compared with the theoretical predictions based on a kinetic model for the CO laser. (auth)

23116 (AD-759861) CO-LASER. Results of Experimental Investigations. Sobolv, N. N.; Sokovikov, V. V. Translated from Tr. Fiz. Inst., Akad. Nauk SSSR; No. 33, 1-63(1972). 50p. NTIS $4.50.

Until recently the most outstanding representatives of gas lasers were the CO_2- and Ar^+-lasers, to which survey articles have been dedicated. At the present time, to these two lasers, it is also possible to add the CO-laser, which with respect to power is comparable to the Ar^+-laser, and in efficiency to the CO_2-laser. The results of the developments and investigations of the CO-lasers are presented. The population inversion mechanism in CO-lasers is discussed. (NTIS)

23117 (AD-760701) RESEARCH ON MOLECULAR LASERS. Semiannual Report, 1 October 1972–31 March 1973. Wolga, G. J.; Bauer, S. H.; McFarlane, R. A.; Cool, T. A. (Cornell Univ., Ithaca, N. Y. (USA)). 15 Apr 1973. Contract N00014-67-A-0077-0006. 24p. NTIS $3.00.

Research concerning molecular and chemical lasers was conducted in the following areas: measurement of V yield V and V yield R, T rates among hydrogen halide molecules and the temperature dependence of the energy transfer rates previously determined for HF, DF, HF/CO_2 DF/CO_2 systems; vibrational relaxation studies of CO_2 in the pressure range 1 to 100 atm; chemical laser studies of the reaction of atomic oxygen and acetylene; computer modeling of the CS_2-O_2 chemical laser system; chemical laser studies of the reaction of C_3O_2 with oxygen; experimental study of the relaxation of CO_2(001) and HF(v = 1) by collisions with H and F atoms; and studies of the influence of vibrational excitations on the reaction rate of atom exchange reactions, e.g., HF(v) + D2 yield HD + DF. (NTIS)

23118 (AD-762334) DESIGN, FABRICATION, AND DELIVERY OF A LINE SELECTABLE CO LASER. Final Technical Report, 28 February 1972–November 1973. Buczek, C. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). Mar 1973. Contract F30602-72-C-0248. 28p. NTIS $3.00.

The technical background, design features, hardware and per-

formance of a line selectable CO laser system are discussed. This laser was designed to operate with a high degree of amplitude stability and provides for line selection from 5.04 to 5.6 μ. The laser utilizes a three-element (two mirrors and one grating) optical resonator to achieve wavelength selectivity in a very high Q (low loss) optical configuration. This optimized configuration along with other design features has resulted in long term sealed tube operation with power outputs on single line from 0.1 to 1.00 W in the TEM sub (oo) mode. (auth)

23119 (AD-762817) CHEMICAL LASERS: A COMPREHENSIVE LITERATURE SURVEY. Arnold, S. J.; Rojeska, H. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). 28 Apr 1972. 15p.

In Appl. Opt.; 12: No. 2, 169-181(Feb 1973).

A bibliography of chemical laser publications covering the period 1964 through 1971 has been compiled. The chronologically listed references are followed by tables showing the chemical systems exhibiting laser action and by an alphabetical author index. (auth)

23120 (AD-762826) NEAR-INFRARED LASERS FOR HCHO. Barry, J. D.; Boney, W. E.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 13 Nov 1972. 2p. NTIS.

In Amer. Inst. Phys.; 44: No. 4, 1915-1916(Apr 1973).

Both CO and CO_2 cw laser emissions have been produced from gaseous HCHO premixed with He and air. The CO and CO_2 molecules are produced from the HCHO by oxidation reactions initiated by a glow discharge through the flowing gas mixture within the laser cavity. The CO laser action occurred with liquid-nitrogen cooling, increasing the temperature to −40°C or to room temperature, caused the change to CO_2 laser action. (auth)

23121 (AD-762827) CO AND CO_2 LASER ACTION BY ORGANIC MOLECULE OXIDATION. Boney, W. E.; Barry, J. D.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 2 Oct 1972. 2p. NTIS.

J. Quan. Electron.; QE-9: No. 2, 246-247(Feb 1973).

23122 (AD-762836) 4.9-MICRON He-AIR-CH_4-(CO) LASER. Barry, J. D.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 13 Jan 1971. 2p. NTIS.

In IEEE J. Quant. Electron.; QE-7: No. 5, 208-209(May 1971).

Low-vibrational-level $P(J)_{v,v'}$ CO laser emissions have been measured from He-air-CH_4 mixtures. The cw lines below 5.0 were measured in air to occur at 4.8836, 4.8935, 4.8974, 4.9072, 4.9366, 4.9466, 4.9670, and 4.9778 μ. These emissions are tentatively identified to result from transitions as low as v = 3:2. Such emissions were relatively more frequent with CH_4 than with CO specifically. (auth)

23123 (AD-763795) INVESTIGATE MATERIAL SYSTEMS FOR MIRRORS USED IN HIGH POWER CO AND CO_2 LASERS. Semiannual Technical Report. Stewart, R. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1972. Contract N00123-72-C-2215. 78p. NTIS $3.00.

Results are presented from the first phase of a three-phase program to develop a laser mirror material system. Copper, dispersion hardened with the addition of 0 to 5 vol% SiC or Al_2O_3 was deposited by high-rate sputtering to produce a stable, fine-grain (0.4 μ) polishable material exhibiting a surface roughness of less than 15 Å rms when it was mechanically polished. Instruments for measuring surface roughness by scattered light and mirror absorption by differential calorimetry were also designed, constructed, and successfully employed in measuring surface properties and mirror optical absorption. (auth)

23124 (AD-763905) DEVELOPMENT AND APPLICATION OF ANALYTICAL MODELS FOR CHEMICAL LASERS. Part I. Final Report. Thoenes, J.; Ratliff, A. W. (Lockheed Missiles and Space Co., Huntsville, Ala. (USA)). May 1973. Contract DAAH01-72-C-0493. 116p. NTIS $5.45.

A new laser and mixing analysis is described which considers the coupling between gasdynamic properties, cavity characteristics, and resulting laser radiation for diffusion-type chemical laser oscillator cavities. The formulation assumes parallel mixing and constant lateral pressure with lasing due to single or multiple transitions between certain vibrational/rotational molecular energy levels. Excitation of the active medium traversing a Fabry–Perot optical cavity is caused by highly exothermic reactions between gradually mixing reactants discharged from a grid nozzle. Uniform, premixed, inviscid laser cavity flows can be investigated as a special case of the more general analysis. Typical results are given for both uniform premixed and gradually mixing two-dimensional cavity flows. Volume I of this two-part final report documents the work accomplished on the development of the gain and power calculations, radiation model and its implementation into the constant lateral pressure Laser and Mixing Program (LAMP). (auth)

23125 (AD-763906) DEVELOPMENT AND APPLICATION OF ANALYTICAL MODELS FOR CHEMICAL LASERS. Part II. Final Report. Ratliff, A. W.; Thoenes, J. (Lockheed Missiles and Space Co., Huntsville, Ala. (USA)). May 1973. Contract DAAH01-72-C-0493. 97p. NTIS $4.85.

The document is Volume II of a two-part final report. It deals with the effort involved in generating a Method-of-Characteristics Laser and Mixing Program (MOC-LAMP) to accommodate chemical laser flows and reactants in the presence of both axial and lateral pressure gradients. Portions of Volumes I and II are repetitive to provide completeness and consistency. (NTIS)

23126 (AD-764449) SIMULTANEOUS CO AND CO_2 LASER. Barry, J. D.; Boney, W. E.; Roll, W. A. Jr.; Brandelik, J. E. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). 5 Feb 1973. 2p. (AFAL-TR-73-237). NTIS.

In IEEE J. Quant. Electron.; QE9: No. 7, 779-780(Jul 1973).

CW laser action at both the 5- and 10.6-μm wavelength regions has been achieved simultaneously from CO and CO_2 molecules in a slowly flowing mixture of He-air-CO. Two dc discharges through the premixed gases within a segmented laser cavity were used to provide molecular excitation and generate CO_2 molecules by discharge-initiated CO oxidation. Both liquid nitrogen and room-temperature water cooling were used concurrently. A total power of about 2 W has been achieved with approximately half the power in each wavelength region. (auth)

23127 (AD-764808) CONSOLIDATED QUARTERLY REPORT FOR THE PERIOD OCTOBER 1, 1972–DECEMBER 31, 1972. Boye, J. R.; Durney, C. H.; Gandhi, O. P.; Grow, R. W.; Hou, J. L. (Utah Univ., Salt Lake City (USA). Microwave Device and Physical Electronics Lab.). 31 Dec 1972. Contract N00014-69-C-0345. 132p. NTIS $4.50.

The broad purpose of the research activity reported is to extend the useful frequency spectrum into the range from microwave frequencies to optical frequencies and to improve existing devices and techniques in the microwave spectrum. At present this objective is being pursued by studies of electron beam devices, quantum electronic devices, plasmas, and solid-state devices. (auth)

23128 (AD-765350) ATMOSPHERIC PRESSURE GAS LASERS. Semiannual Technical Report, 1 December 1972–31 May 1973. Haus, H. A. (Massachusetts Inst. of Tech., Cambridge (USA)). 26 Jan 1973. Contract DAHC04-72-C-0044. 69p. NTIS $3.50.

The following topics are discussed: mode locking and pulse selection; and closed-form analysis of electron distribution and pumping rates. In addition, the following preprints are included: generation and amplification of high-intensity nanosecond tea CO_2 laser pulses; model of mode locking with saturable absorber; and electron distributions in gas lasers. (NTIS)

23129 (AD-769103) INVESTIGATE MATERIAL SYSTEMS FOR MIRRORS USED IN HIGH POWER CO AND CO_2 LASERS. Semiannual Technical Report. Stewart, R. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1973. Contract N00123-72-C-2215. 37p. (BNWL-1781). NTIS $3.00.

An ir metal mirror with up to ~99.2% reflectivity and a surface roughness of about 15 Å rms was developed using high-rate sputter-deposition techniques. The necessary smooth, high-conductivity surface was obtained by applying two sequentially deposited metal layers on a high-conductivity metal mirror support (OFHC). The principal property of the first deposit was its polishability and of the second its high electrical conductivity. The required smooth surface was obtained by depositing and mechanically polishing a dispersion-hardened (1 vol% SiC in Cu), stable, fine-grained material about 0.5 mm thick. (auth)

23130 (AD-770074) SCALING GENERALIZATIONS FOR A PULSED CO EDL (ELECTRIC DISCHARGE LASER). Lacina, W. B. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Oct 1973. Contract N00014-72-C-0043. 50p. (NRTC-73-43R). NTIS $3.00.

Several scaling generalizations for a pulsed CO EDL laser are presented and discussed. Quantum efficiency is shown to be mainly dependent upon total energy deposition as a function of time. Typically, turn-on occurs after ~J/liter/torr has been deposited, and steady state after ~2 J/liter/torr. Scaled saturation intensity is ~0.6 to 6.0 W/cm²/torr squared.

23131 (AD-777960) CARBON MONOSULFIDE AND CO PROBE LASER RESEARCH. Final Technical Report, 15 June 1972–31 July 1973. Jeffers, W. Q.; Powell, H. T. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). 31 Jul 1973. Contract N00014-72-C-0458. 80p. (MDC-Q0498). NTIS $5.25.

The subject contract was divided into two major efforts: (1) an investigation of CS-fueled CO chemical lasers, and (2) experimental measurements of CO vibrational relaxation by means of probe laser transient gain experiments. (auth)

23132 (AD-779823) SOLID STATE RESEARCH, 1974:1. Quarterly Technical Summary, 1 November 1973–31 January 1974. McWhorter, A. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Feb 1974. Contract F19628-73-C-0002. 88p. NTIS $4.00.

The solid state research work of the Solid State Division at Lincoln Laboratory for the period November 1, 1973 through January 31, 1974 is discussed. The topics covered are solid state device research, quantum electronics, materials research, physics of solids, and microelectronics. The microsound work is sponsored by ABMDA and is reported under that program. (auth)

23133 (AD-780331) ABSOLUTE FREQUENCY MEASUREMENTS OF $^{12}C^{16}O$ AND $^{13}C^{16}O$ LASER TRANSITIONS. Whitford, B. G.; Siemsen, K. J.; Riccius, H. D. (National Research Council of Canada, Ottawa, Ontario. Div. of Physics). 18 Jan 1974. 3p. NTIS.

In Opt. Commun. 10: No. 3, 288-289(Mar 1974).

The absolute frequencies of one 5.2 μ ^{12}C ^{16}O laser line and one 5.3 μ ^{13}C ^{16}O laser line have been measured against micrometer band transitions of the CO_2 laser by heterodyning in a tungsten-nickel diode. The frequencies, wavelengths and wave numbers of these lines are reported to an accuracy of one part in ten million. (auth)

23134 (AD-783634) SOLID STATE RESEARCH, 1974:2. Quarterly Technical Summary Report, 1 February–30 April 1974. McWhorter, A. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 May 1974. Contract F19628-73-C-0002. 57p. NTIS $3.75.

The solid state research work of the Solid State Division at Lincoln Laboratory for the period February 1 through April 30, 1974 is discussed. The topics covered are solid state device research, quantum electronics, materials research, physics of solids, and microelectronics. (auth)

23135 (AD-785095) DETERMINATION OF ABSOLUTE FREQUENCIES OF $^{12}C^{16}O$ AND $^{13}C^{16}O$ LASER LINES. Eng, R. S.; Keldal, H.; Mikkelsen, J. C.; Spears, D. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Nov 1973. 4p. (JA-4274). NTIS.

In Appl. Phys. Lett.; 24: No. 5, 231-233(1 Mar 1974).

The absolute frequencies of one $^{13}C^{16}O$ and seven $^{12}C^{16}O$ laser lines have been determined with an uncertainty of about ± 5 MHz by measuring the beat frequencies between these CO lines and second harmonics of CO_2 laser transitions generated in a $CdGeAs_2$ frequency-doubling crystal. Beat frequencies up to 11 GHz have been measured using a high-speed HgCdTe detector. (auth)

23136 (AD-787694) INITIAL STUDIES ON A MONOPROPELLANT CHEMICAL LASER SYSTEM UTILIZING NITROSYL CYANIDE. Buelow, L. D. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Sep 1974. 67p. NTIS $4.25.

Thesis.

A continuous gas flow method for the production of nitrosyl cyanide has been devised and the potential of using nitrosyl cyanide in a pumping reaction for monoreagent CO laser is discussed. The infrared, visible, and ultraviolet spectra have been recorded. The infrared analysis located and assigned vibrational fundamentals. The diagonal force constants were determined. Some thermodynamic properties are reported. (auth)

23137 (AD/A-000516) EFFICIENT DOUBLING AND CW DIFFERENCE FREQUENCY MIXING IN THE INFRARED USING THE CHALCOPYRITE $CdGeAs_2$. Kildal, H.; Mikkelsen, J. C. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 14 Jan 1974. Contract F19628-73-C-0002. 6p. (JA-4308). NTIS.

In Opt. Commun.; 10: No. 4, 306-309(Apr 1974).

A 15% average internal power conversion efficiency was obtained for second harmonic generation in $CdGeAs_2$ of radiation from a TEA CO_2 laser operating at 10.6 μ. This is the highest reported doubling efficiency for a CO_2 laser. The cw difference frequency mixing in $CdGeAs_2$ at wavelengths between 11.4 and 16.8 μ using grating-tuned CO and CO_2 lasers. The $CdGeAs_2$ crystals are significantly improved in size and optical quality over those previously available. (auth)

23138 (AD/A-002609) VIBRATION-TO-VIBRATION ENERGY TRANSFER IN N_2 + CO IN THE TEMPERATURE REGION 100 TO 3000°K. Shin, H. K. (Nevada Univ., Reno (USA). Dept. of Chemistry). 19 Apr 1974. 4p. NTIS $3.25.

In J. Chem. Phys.; 61: No. 6, 2474-2475(15 Sep 1974).

A theoretical approach recently formulated (J. Chem. Phys., 60, 1064 (1974)) has been used to calculate the probability of vibration-to-vibration energy transfer in nitrogen molecule (v = 1) + carbon monoxide (v = 0) yields nitrogen molecule (v = 0) + carbon monoxide (v = 1) in the temperature range of 100 to 3000°K. It is shown that the calculated values are in good agreement with shock-wave data at high temperatures and laser-excited fluorescence measurements at low temperatures. (auth)

23139 (AD/A-006101) INVESTIGATE MATERIAL SYSTEMS FOR MIRRORS USED IN HIGH POWER CO AND CO_2 LASERS. Stewart, R. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract N00123-72-C-2215. 79p. NTIS $4.75.

The viability of a mirror structure concept formed by sputter deposited materials is demonstrated. The mirror concept would be used in high energy CO, CO_2, and other infrared laser systems at the infrared wavelength of 10.6 μ. Sputtered deposits of Cu-1 vol% SiC on a variety of metal substrates provided surfaces that could be reproducibly polished using conventional techniques to an rms roughness of 20 Å or less. Sputter-deposited germanium and CdTe were found to have optical properties near those of bulk material. Sputter deposition of quarter-wavelength reflectivity enhancement coatings therefore appears feasible. The results of limited laser damage testing were exceptional considering that there was not time to optimize material properties. (NTIS)

23140 (AD/A-006117) PARAMETRIC INVESTIGATION OF THE Na–^{20}N + CO CHEMICAL LASER. Benson, R. C.; Bargeron, C. B.; Walker, R. E. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Oct 1974. Contract N00017-72-C-4401. 32p. (APL-TG-1266). NTIS $3.75.

An investigation has been performed on the Na-catalyzed N_2O + CO chemical laser. Although the results indicate that at least six chemical reactions are involved, the simple chain reaction, which apparently leads to lasing action, is Na + N_2O to N_2 + NaO + 21.0 kcal/mole and NaO + CO to CO_2 + Na + 66.2 kcal/mole. Measurements were made in the transverse-flow configuration. Gain measurements have been made along the reaction length as a function of the CO/N_2O ratio, combustion efficiency, and pressure. Several aspects of the chemical reactions have been studied. Several possible reactions are discussed. (NTIS)

23141 (AD/A-006706) HETERODYNE MEASUREMENTS OF $^{12}C^{16}O$ LASER FREQUENCIES AND IMPROVED DUNHAM COEFFICIENTS. Kildal, H.; Ross, A. H.; Eng, R. S. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 3 Jun 1974. Contract F19628-73-C-0002. 11p. (JA-4358). NTIS $3.25.

In J. Mol. Spectrosc.; 53: 479-488(1974).

Earlier measurements of absolute frequencies of $^{12}C^{16}O$ laser lines by heterodyning with second harmonics of a $^{12}C^{16}O_2$ laser have been extended to 15 more lines by use of the rare isotopes $^{12}C^{16}O_2$. Interband difference frequencies for 20 pairs of $^{12}C^{16}O_2$ lines have also been measured by heat frequency techniques. These data together with 1038 other previously reported frequency measurements in the microwave and infrared regions were analyzed to determine coefficients of a Dunham series. Transition frequencies predicted from the derived coefficients are substantially more accurate than earlier tabulations, having estimated uncertainties of the order of 2 MHz in the strongest laser bands. The coefficient Y31 was determined for the first time. (auth)

23142 (AD/A-006978) DEVELOPMENT OF IR TRANSMITTING CHALCOGENIDE WINDOWS. Final Technical Report, 1 April 1972–30 September 1974. Moynihan, C. T.; Macedo, P. B.; Maklad, M. S.; Mohr, R. K.; Howard, R. E. (Catholic Univ. of America, Washington, D. C. Vitreous State Lab.). Feb 1975. Contract N00014-67-A-0377-0017. 38p. NTIS $3.75.

A quantitative study of infrared absorption in the 250 to 4000/cm region of As_2Se_3 glasses doped with small amounts of As_2O_3 or purified has been carried out with particular attention to absorption in the wavelength regions of the CO_2 and CO lasers. The dependence of the relative intensities of the oxide impurity bands in the 650 to 1340/cm region on the total amount of As_2O_3 added to the glass indicates the existence of three distinct oxide impurity species. A number of higher frequency impurity bands which are due to the presence of hydrogen in the glass and whose intensities are highly dependent on the glass melting conditions have been observed and classified. Intrinsic multiphonon absorption coefficients of mixed As_2Se_3–$GeSe_2$ glasses were found to be of the same magnitude at the same respective frequencies as those for pure As_2Se_3 glass. (NTIS)

23143 (AD/A-007241) ENERGY TRANSFER PROCESSES IN MOLECULAR LASERS. Final Technical Report, 26 January 1971–30 June 1974. Fisher, E. R.; Abraham, G.; Lightman, A.; Morgan, L.; Yarema, S. (Wayne State Univ., Detroit, Mich. (USA). Research Inst. for Engineering Sciences). 6 Jan 1975. Contract DAHC04-74-G-0036. 126p. NTIS $5.75.

This final report details neutral energy transfer and molecular plasma models which have been developed. These numerical models are exercised on pulsed CO lasers both with and without gas additives. The important phenomenology operative in the CO laser is indicated. Experiments are also presented on the operating characteristics of a cw CO laser both with and without gas additives. These experimental measurements are discussed in the framework of the important plasma and neutral chemistry processes. Sections included are entitled: Modeling of a pulsed CO/N_2 molecular laser system: effect of temperature and mixture components; and calculations on the electron energy distribution in a molecular laser plasma. (NTIS)

23144 (AD/A-008953) COLLISIONAL ENERGY TRANSFER AND TOPICS RELATED TO THE GAS LASER MECHANISM. Final Report, 1 December 1972–31 December 1974. Sharma, R.; Javan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 10 Mar 1975. 6p. NTIS $3.25.

Through the two year period of the grant the work done represented important steps in the theory of energy transfer during molecular collisions and the theory of collision-induced absorption. Experimental work included measurement of the rates and temperature dependencies for near-resonant transfer processes in several systems. These results were explained by the appropriate theoretical methods using long-range multipolar interactions and the distorted-wave first-order Born approximation. Collision-induced absorption coefficients in rare gas mixtures were also calculated. Eight journal publications resulted from this research. (NTIS)

23145 (AD/A-010204) COLLISION STUDIES OF GASEOUS MOLECULAR LASERS. Rabitz, H. (Princeton Univ., N. J. (USA). Dept. of Chemistry). 20 May 1975. Contract N00014-75-C-0478. 12p. NTIS $3.25.

Collisional relaxation studies under way at Princeton are reviewed. Three areas of research are involved: Vibration-translation rate calculations in $He-CO_2$; rotation-translation relaxation in hydrogen; and a stochastic theory for strong collisions. (NTIS)

23146 (AD/A-010462) LOW LOSS WINDOW MATERIALS FOR CHEMICAL AND CO LASERS. Harrington, J. A.; Bendow, B.; Namjoshi, K. V.; Mitra, S. S.; Stierwalt, D. L. (Air Force Cambridge Research Center, Mass. (USA)). 15 May 1975. 26p. (AFCRL-TR-75-0275). NTIS $3.75.

The optical absorption has been measured in a variety of materials (such as fluorides and titanates, which are candidates for service as low loss windows on DF-HF chemical or CO lasers. Measurements of the absorption coefficient beta at DF (3.8 μm) and HF (2.7 μm) frequencies were accomplished using cw chemical laser calorimetry. Beta as a function of frequency was obtained for the alkaline earth fluorides by measuring the spectral emittance at 100C. A phenomenological model has been employed to calculate beta for these hosts as a function of frequency. Good results indicate that the absorption in most materials studied is limited by extrinsic processes. At HF frequencies, hydroxyl ions in the bulk or on the surface are believed responsible for the high beta values. At both DF and HF frequencies surface absorption appears to be strong owing in part to absorption by organics which are often used in surface finishing. (NTIS)

23147 (CONF-740767-P1, pp 221-239) SPIN-FLIP RAMAN LASER. Weiler, M. H.; Aggarwal, R. L.; Lax, B. (Massachusetts Inst. of Tech., Cambridge). 1974.

From international conference on the application of high magnetic fields in semiconductor physics; Wuerzburg, Germany, German, Federal Republic of (F.R. Germany) (24 Jul 1974).

In application of high magnetic fields in semiconductor physics. Part I.

The history of stimulated spin-flip Raman scattering is reviewed. Recent theoretical and experimental progress is discussed for the InSb spin-flip Raman laser. Present and future applications are described. (auth)

23148 (COO-2723-1) EXPLORATORY STUDY OF METAL VAPOR LASERS OPERATING IN THE ULTRA-VIOLET AT KILOWATT POWER LEVELS. Technical Progress Report, June 1, 1975–May 1, 1976. Collins, G. J. (Colorado State Univ., Fort Collins (USA)). Mar 1976. Contract E(11-1)-2723. 6p. Dep. NTIS $3.50.

Three laser research programs are proposed: (1) to find new laser systems in the wavelength region between 2000 and 4500 A; (2) to attempt scaling lasers to high output power; and (3) to focus research on metal vapor laser systems which have promise of high efficiency. Twenty-eight new laser transitions from Cu II spanning the wavelength region from 2486 to 7988 A have been observed. A list of papers and conferences are given that summarize the metal vapor laser research. (TFD)

23149 (N-72-15488) DIATOMIC GASDYNAMIC LASERS. McKenzie, R. L. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Dec 1971. 37p. (NASA-TM-X-62099). NTIS $3.00.

Predictions from a numerical model of the vibrational relaxation of anharmonic diatomic oscillators in supersonic expansions are used to show the extent to which the small anharmonicity of gases like CO can cause significant over-populations of upper vibrational states. When mixtures of CO and N_2 are considered, radiative gain on many of the vibration-rotation transitions of CO is predicted. Experiments are described that qualitatively verify the predictions by demonstrating laser oscillation in $CO-N_2$ expansions. The resulting $CO-N_2$ gasdynamic laser displays performance characteristics that equal or exceed those of similar CO_2 lasers. (NTIS)

23150 (N-73-10525) CS_2/O_2 CHEMICAL LASERS CHEMISTRY AND PERFORMANCE CHARACTERISTICS. Suart, R. D.; Dawson, P.; Kimbell, G. H. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). Aug 1972. 32p. NTIS $3.75.

Experimental results from the carbon disulfide/oxygen chemical laser system using both a flash photolysis initiated pulsed laser and a microwave discharge initiated continuous wave laser were examined by computer simulation techniques. The comparisons between predicted and observed laser performance and the resulting conclusions concerning the chemical mechanisms operative in the laser are discussed. It was determined that the continuous wave laser operates on totally vibrational level populations when cold carbon monoxide is added to the reaction mixture. (auth)

23151 (N-73-16538) EQUATIONS FOR THE KINETIC MODELING OF SUPERSONICALLY FLOWING ELECTRICALLY EXCITED LASERS. Lind, R. C. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Jan 1973. 29p. (NASA-TM-X-62196). NTIS $3.50.

The equations for the kinetic modeling of a supersonically flowing electrically excited laser system are presented. The work focuses on the use of diatomic gases, in particular carbon monoxide mixtures. The equations presented include the vibrational rate equation which describes the vibrational population distribution, the electron, ion and electronic level rate equations, the gasdynamic equations for an ionized gas in the presence of an applied electric field, and the free electron Boltzmann equation including flow and gradient coupling terms. The model developed accounts for vibration–vibration collisions, vibration-translation collisions, electron-molecule inelastic excitation and superelastic de-excitation collisions, charge particle collisions, ionization and three body recombination collisions, elastic collisions, and radiative decay, all of which take place in such a system. A simplified form of the free electron Boltzmann equation is developed and discussed with emphasis placed on its coupling with the supersonic flow. A brief description of a possible solution procedure for the set of coupled equations is discussed. (auth)

23152 (N-74-34909) CAUSES OF POWER DEGRADATION IN A HIGH-REPETITION RATE TEA CO_2 LASER. Suart, R. D.; Levesque, R. J.; Snelling, D. R. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). Mar 1974. 53p. NTIS $4.25.

Output power, gas charge composition, and electrical discharge properties of the intermediate high repetition rate laser (intermediate HRRL) were measured. Factors, other than the normal progressive loss of CO_2 due to electrical discharge, controlling the output power were investigated. The conversion of CO_2 into CO an O_2 is an important effect leading to power loss in the HRRL. (auth)

23153 (NTIS/PS-75/018) GAS DYNAMIC LASERS (A BIBLIOGRAPHY WITH ABSTRACTS). Report for 1964–October 1974. Werner, K. G. (National Technical Information Service, Springfield, Va. (USA)). Jan 1975. 90p. NTIS $25.00.

The bibliography covers kinetic and energy transfer processes, design, and performance of gas and chemical lasers relying on gas dynamic effects for lasing enhancement. Diffusion and flow studies specifically applicable to such lasers are also included. There are 85 selected citations included in the bibliography. (NTIS)

23154 (NTIS/PS-75/658) CARBON MONOXIDE LASERS (A BIBLIOGRAPHY WITH ABSTRACTS). Period Covered: 1964–August 1975. Smith, M. F. (National Technical Information Service, Springfield, Va. (USA)). Aug 1975. 170p. NTIS $25.00.

One-hundred twenty four references to literature pertaining to CO lasers are presented. (TFD)

23155 (PB-221982) REPORT OF NRL PROGRESS, APRIL 1973. (Naval Research Lab., Washington, D. C. (USA)). Apr 1973. 85p. NTIS $3.00.

The report discusses nuclear sciences and technology at NRL; and neutron radiotherapy at NRL. In addition, brief articles are included in other fields of acoustics, chemistry, electronics, metallurgy, ocean sciences, ocean technology, radar, and structural dynamics. (NTIS)

23156 (UCRL-51984) THEORETICAL TOOL MOVEMENT REQUIRED TO DIAMOND TURN AN OFF-AXIS PARABOLOID ON AXIS. Thompson, D. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $3.50.

High-quality, off-axis parabolic reflectors, required by the CTR and laser-fusion programs at Lawrence Livermore Laboratory (LLL) and other ERDA laboratories, are currently manufactured by hand. There are several drawbacks to this method, including lead times of up to a year, costs in excess of $75,000 for a small reflector, and unsatisfactory limits to the tolerances obtainable. This situation has led to a search for cheaper and more accurate methods of manufacturing off-axis paraboloids. An alternative method, turning the workpiece about its axis on a diamond-turning machine, is presented, and the equations describing the necessary tool movement are derived. A discussion of a particular case suggests that the proposed technique is feasible. (auth)

23157 DELAY IN STIMULATED EMISSION OF GALLIUM ARSENIDE DIODES. Prokhorenko, A. S.; Shavel, N. N. Arsenid Galliya; No. 4, 238-241(1974). (In Russian)

Experimental measurements were made of the delay of the onset of generation relative to the onset of the current pulse in injection GaAs lasers. The measurements were made at 77°K. Investigations were made of samples of diffusion and heterolasers with one heterojunction. The slope of the front of the pulses of current was about 0.3 ns, the measured delay times were 0.5 to 5 ns. A formula was derived to calculate the dependence of delay time on injection current for sufficiently long pulses of threshold current. This formula may be theoretically obtained on the assumption of independence of spontaneous lifetime of the injected carriers from the injection current. (Ref. Zh.)

23158 RECORDING OF LASER RADIATION BY A HOLLOW CERAMIC CYLINDER. Morozov, B. N.; Nikolaev, E. P.; Russov, V. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 38: No. 2, 214-215(Feb 1975).

Translated from Opt. Spektrosk.; 38: No. 2, 382-384(Feb 1975).

A hollow cylinder of polarized lead titanate zirconate was used to demonstrate the use of the pyroelectric effect as a means of recording laser radiation. (GHT)

23159 STUDIES OF THE PHYSICO-CHEMICAL PROPERTIES OF CO_2-LASER PLASMA. Ochkin, V. N. pp 3-59 of Study of the Plasma of Molecular Lasers. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Dissociation of CO_2 in a gas-discharge plasma produced by a CO_2 laser is studied using ir absorption techniques. It is found that the degree of CO_2 dissociation in continuous-flow CO_2 lasers is considerable even in cases of relatively fast pumping and can attain 60% or more. The density of vibrational inversion is calculated with allowance for dissociation. It is shown that this density is substantially inhomogeneous along the length of the discharge tube in continuous-flow systems due to the plasma's inhomogeneous chemical composition. Both the electrode materials and their processing conditions are found to be important in sealed-off systems, and processes are discussed which determine the lifetime of a sealed-off CO_2 laser. The vibrational temperature in N_2, N_2-CO_2, and N_2-CO_2-He are measured in the principal electron states in terms of relative intensities in the second positive system of nitrogen. (IAA)

23160 EXPERIMENTAL STUDY OF THE ELECTRICAL AND OPTICAL PROPERTIES OF THE POSITIVE COLUMN OF A GLOW DISCHARGE IN MOLECULAR GASES. Novgorodov, M. Z. pp 60-116 of Study of the Plasma of Molecular Lasers. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The electron-energy distribution functions, total electron density, and band intensity in a glow discharge in pure molecular gases used in CO_2 lasers as well as in mixtures of these gases with helium and xenon are studied by experimental probe, HF, and optical techniques. The effect of electron runoff to a cylindrical probe is examined together with its influence on probe characteristics and their derivatives. A method is proposed for obtaining an unperturbed distribution function, and obtained functions are used to calculate the excitation rate of molecular vibrational levels participating in the production of an inverted population. The results of these studies indicate that the electron-energy distribution in mixtures of molecular gases is not Maxwellian. (IAA)

23161 NEODYMIUM GLASS SCANNING LASER WITH ELECTROOPTICAL TUNING OF THE DISPERSION RESONATOR. Galich, G. A.; Kravchenko, V. I. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1732-1735(Oct 1975). (In Russian).

An electrooptical tuning of the dispersion resonator was developed and the spectral-kinetic characteristics of the Nd glass scanning laser were investigated at slow scanning rates. The method developed for the scanning of frequencies was based on the combination of dispersion prisms with electrooptical deflectors placed in the optical resonator of the laser. A substantial realization was obtained of the kinetics and spectra of the laser radiation and the possibility of developing a wide-range frequency tuner of the induced radiation was confirmed. (tr-auth)

23162 Nd^{3+} GLASS LASER IN THE DEPARTMENT OF ENGINEERING PHYSICS AT THE A.N.U. Inall, E. K. (Australian National Univ., Canberra). At. Energy Aust.; 18: No. 3, 2-6(Jul 1975).

In 1970 it was decided to assess the feasibility of pumping a high power laser from the homopolar generator. The first stages of such a laser were built as part of the project to enable the development and testing of special techniques involved. Details of the configuration and construction of the laser system are described. (AT)

23163 CONTINUOUS WAVE, FREE-BURNING FLAME LASER. Pilloff, H. S.; Searles, S. K.; Djeu, N. I. (to Dept. of the Navy, Washington, DC). US Patent 3,760,293. 18 Sep 1973. Filed Date 24 Feb 1972. 5p.

A self-sustaining infrared continuous wave laser in which laser oscillation is achieved from a free-burning flame in a vacuum is described. Laser action is maintained as long as the chemical agents are supplied and burned. CS_2 and O_2 are injected from alternate tubes and burned together to form CO with a population inversion between vibration-rotation levels. The optical cavity is formed by spaced dielectrically coated mirrors. The flame is ignited by a glow discharge several inches above the burner. The discharge is turned off once the flame is started. (NTIS)

23164 SIMULTANEOUS CO AND CO_2 LASER. Brandelik, J. E. (to Dept. of the Air Force, Washington, DC). US Patent Application 439,662. Filed 4 Feb 1974. 11p.

A gas laser is described that has two different and simultaneous discharge cooling temperatures of approximately 77 and 300°K and a premixed flowing gaseous mixture of helium, air, and carbon monoxide, with pressure ratios of approximately 21-3-1 respectively, at a total pressure of approximately 10 torr. It provides laser radiation from the CO molecules at approximately 5 μ wavelength and simultaneous laser radiation from the CO_2 molecules, formed in the laser tube by CO dissociation oxidation in the dc discharge, at approximately 10.6 wavelength. (NTIS)

23165 CARBON MONOXIDE LASER FROM HELIUM-AIR-METHANE MIXTURE. Barry, J. D.; Boney, W. E. (to Dept. of the Air Force, Washington, DC). US Patent 3,704,428. 28 Nov 1972. Filed Date 4 Oct 1971. 7p.

A gas laser charged with a mixture of helium-air-methane, operable in both the Q-switched and cw mode is described. It forms vibrationally excited CO molecules by the electric discharge induced chemical oxidation of methane. The resulting laser output provides at least 80 laser emission lines in the region from 4.7848 to 5.8532 μ, with 20 lines below 5 μ. Multiline pulse powers greater than two kW may be obtained from the molecules formed by the electrochemical reaction. (NTIS)

23166 A. FLUCTUATION PHENOMENA IN QUANTUM OPTICS. B. The Construction of a CO_2 TEA Laser. Chow, W. W. Tucson, AZ; Univ. of Arizona (1975). 84p. University Microfilms Order No. 76-2537.

Thesis (Ph. D.).

This dissertation may be divided into three parts. The first part proposes and analyzes the use of quantum beat phenomena to test neoclassical radiation theory (NCT) and quantum electrodynamics (QED). For a beam foil type of experiment with atoms

having one upper level and two closely spaced lower levels, all coherently excited, NCT predicts the presence of quantum beats in the emitted radiation; beats are not expected in QED. QED predicts beats when many atoms are present, in agreement with recent photo-echo experiments. An experiment to test NCT and QED is suggested. The second part calculates, via the quantum noise operator approach, the power spectral density of a laser subjected to a symmetry-breaking injected signal. The resulting spectrum is sharpened. It is further noted that these considerations are potentially of interest in producing high intensity fields in small focal volumes. The final portion presents a description of a high power CO_2 TEA laser that was built for use in laser isotope separation experiments. This laser, whose output pulses are each of the order of a few joules, will be used in studies concerning the laser enrichment of SF_6 and the temporal behavior of hot electrons in InSb. (Diss. Abstr. Int., B)

23167 MODE AND RECOMBINATION CONTROL IN SEMICONDUCTOR LASERS. Shurtz, R. R. II. Washington, DC; Catholic Univ. (1975). 225p. University Microfilms Order No. 76-3782.

Thesis (Ph. D.).

A self consistent mathematical description of a semiconductor GaAlAs heterostructure laser has been developed. It includes excess hole and electron injection, diffusion, drift and recombination. The excess carrier motion is described by the ambipolar diffusion equation. The boundary conditions at each heterojunction are found by imposing electron and hole current continuity as well as quasi-Fermi level continuity. The Fermi-level continuity condition is applied using Kane's non-parabolicity for the GAMMA$_1$/sub C/ minimum and a parabolic expression for both the GAMMA$_{15}$ /sub v/ and the X$_1$/sub C/ minima. The effect of aluminum concentration on carrier mobility, effective mass and gap is included. The volume recombination rate is related to the optical gain of the laser in linear fashion using coefficients obtained by integrating over parabolic bands without quasi-momentum conservation. The recombination lifetime is found in a similar manner. The diffusion coefficients are calculated using the generalized Einstein equation. The dependence of the index of refraction in the device upon carrier injection is included. The E-M field is calculated by solving Maxwell's equations for a general five layer dielectric waveguide. Above threshold the gain is assumed to be pinned at the threshold value. For each solution, the E-M field distribution is determined self-consistently for a particular excess carrier distribution. The theory has been applied extensively to many contemporary laser structures, including double heterostructure, single heterostructure and symmetrical optical cavities. Design curves including injection efficiencies, peak power at catastrophic degradation, threshold current density and I-V characteristics have been developed for various cavity geometries and dopants. (Diss. Abstr. Int., B)

23168 ANALYTICAL STUDY OF HIGH FLOW CO ELECTRIC DISCHARGE LASER SYSTEMS. Smith, N. S. Raleigh, NC; North Carolina State Univ. (1975). 118p. University Microfilms Order No. 76-2437.

Thesis (Ph. D.).

A self-consistent model for high flow CO–N_2–He electric discharge laser systems with coincident optical and flow axes is presented. The model employs the multifluid conservation equations, an integral form of the threshold conditions for the lasing transitions, and the electron Boltzmann equation to describe the laser system. The resulting integro-differential system of equations is solved by an iterative numerical technique. The effects of composition, inlet temperature and pressure, total mass flow rate, mirror reflectivity, and input power on the maximum average small signal gain coefficients, the intensities of the lasing transitions, and the efficiency are examined. The results indicate that for a given input power, mirror reflectivity, and N_2 fraction, the efficiency is increased by reducing the inlet temperature, increasing the flow velocity, and/or increasing the CO fraction. Moreover, transitions on the lower vibrational bands can be obtained at the expense of lower efficiencies by reducing the fraction of CO. A new effect which does not appear in analyses of slow flow and transverse flow lasers is identified. When lasing is present in the system, the upper levels in the entrance region where the gain coefficients are negative are pumped above their corresponding values in the non-lasing case by radiation absorption. This effect has the tendency to make the intensities of the higher transitions less sensitive to changes in the gas temperature and residence time in the discharge cavity. (Diss. Abstr. Int., B)

23169 FISSION FRAGMENT EXCITED LASER SYSTEM. McArthur, D. A.; Tollefsrud, P. B. (to Energy Research and Development Administration, Washington, DC). US Patent Application 512,810. Filed date 4 Oct 1974. 14p.

The patent application concerns a laser system and method for exciting lasing action in a molecular gas lasing medium. It involves cooling the lasing medium to a temperature below about 150°K and injecting fission fragments through the lasing medium so as to preferentially excite low lying vibrational levels of the medium and to cause population inversions therein. The cooled gas lasing medium should have a mass areal density of about .005/mu/s cm^2, relaxation times of greater than 50 /mu/s, and a broad range of excitable vibrational levels which are excitable by molecular collisions. CO gas may be used. (NTIS)

23170 SPECTRAL EFFICIENCY OF PULSED HIGH-CURRENT FLASHLAMPS. Gusinow, M. A. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 11, 4847-4851(Nov 1975).

The spectral efficiency of flashlamps is considered as a function of xenon gas pressure, discharge current, and flashlamp bore. A detailed discussion is given concerning the optimum choice of flashlamp bore. (auth)

23171 CONTINUOUS-WAVE (F+H_2) CHEMICAL LASERS: A TEMPERATURE-DEPENDENT ANALYTICAL DIFFUSION MODEL. Herbelin, J.M. (Aerospace Corporation, P.O. Box 92957, El Segundo, California 90245). Appl. Opt. 15: No. 1, 223-235 (Jan 1976).

The development of an analytical model for predicting the performance of HF lasers that result from the mixing of atomic fluorine with molecular hydrogen in continuously flowing systems is described. The model combines a temperature-dependent solution for a premixed laser system with laminar or turbulent flame-sheet mixing schemes to generate closed-form expressions for the two conditions of constant pressure (simulating a free jet) and constant density (simulating a partially confined flow). The various approximations, including a fully communicating cavity and characteristic reaction and deactivation lifetimes, are discussed. Scaling laws that relate power to the total pressure and nozzle parameters are developed. Comparison with exact numerical treatments for a wide range of conditions reveals that the model is consistently accurate to ~10%. Finally, the sensitivity of the predictions to the kinetic rate package and the utility of the model for performing parameter studies are indicated. (auth)

23172 LASER GAIN PROFILING WITH UNIFORM-FIELD ELECTRODES. Robinson, A.M. (Electrical Engineering Department, University of Alberta, Alberta, Canada). J. Appl. Phys. 47: No. 2, 608-613 (Feb 1976).

The small-signal gain was measured in a uv-sustained CO_2 laser amplifier employing uniform-field electrodes of the type used by Chang. Four different profiles were utilized and the spatial distribution of the gain differed for each profile. For a given electrode shape there was an input energy which produced a region of constant gain. A dip or saturation of the gain occurred at the center of the discharge if the input energy exceeded the optimum value, while a monotonic decrease in gain away from the discharge center was produced below this value. The dip in the gain distribution appears to be caused mainly by thermal heating of the gas. The flatter electrode profiles produced wider uniform gain distributions and less saturation because less heating occurred. (auth)

23173 ON THE IONIC ASSIGNMENT OF XENON LASER LINES. Hoffmann, V.; Toschek, P.E. (Institut für Angewandte Physik, Universität Heidelberg, D-69 Heidelberg, Germany). J. Opt. Soc. Am. 66: No. 2, 152-154 (Feb 1976).

We have assigned most of the visible xenon laser lines by a study of the time dependence of spontaneous emission whose delay is unambiguously correlated with the ionic state. For 11 lines, ambiguities are resolved, or first assignments are given. (auth)

23174 GHz TUNING OF A PLANAR DYE LASER WITH SINGLE DISPERSIVE ELEMENT. Burlamacchi, P. (Laboratorio di Elettronica Quantistica del C.N.R., Via Panciatichi, 56/30-50127 Firenze, Italy); Pratesi, R. Appl. Phys. Lett. 28: No. 3, 124-126 (1 Feb 1976).

A new scheme for tuning a planar waveguide dye laser is presented. Because of the high gain produced in the waveguide structure, a high-dispersion slit-grating arrangement can be used as a feedback element of the laser. Output energy of a few tens of mJ, which corresponded to the saturated output of the amplifier, was obtained within a 2-GHz bandwidth. A very stable and repeatable output frequency was observed. The device demonstrates that, as long as the waveguide overcomes gain and refractive index inhomogeneities, a much higher energy output can be expected from scaled-up devices. (auth)

23175 HIGH PEAK POWER OUTPUT, HIGH PRF BY CAVITY DUMPING A Nd:YAG LASER. Kruegle, H.A.; Klein, L. (Holobeam, Inc.). Appl. Opt. 15: No. 2, 466-471 (Feb 1976).

Intracavity modation of a Nd:YAG laser at high dumping efficiencies was achieved by driving an acoustooptic quartz modulator with 100 W of rf input power at 450 MHz. Stable output pulses of 25-nsec width and peak powers as high as 570 W were obtained at repetition frequencies up to 2 MHz. It is shown that the oscillation of the circulating laser power in the presence of a perturbation determines the dynamics of cavity dumping and sets a lower limit to the pulse repetition frequency of approximately 200 kHz. (auth)

23176 FREQUENCY STABILITY ASSOCIATED WITH A cw HF LASER. Hinchen, J.J.; Freiberg, R.J. (United Technologies Research Center, East Hartford, Connecticut 06108). Appl. Opt. 15: No. 2, 459-461 (Feb 1976).

The frequency stability of a cw, electrically initiated HF mixing laser was investigated using heterodyne and interferometric techniques. A stability corresponding to 1 part in 10^8 was achieved over an observation time of 150 msec. The data indicated that improved performance would be achieved by increasing the mechanical stability in the optical system. Long-term stability was demonstrated by locking the laser output to the Lamb dip of the lasing transition. Based upon these experiments, the cw chemical laser shows potential as a stable frequency local oscillator for applications such as laser radar and communications. (auth)

23177 LIMITATIONS OF POWER OUTPUTS FROM CONTINUOUSLY OPERATING GaAs-$Ga_{1-x}Al_xAs$ DOUBLE-HETEROSTRUCTURE LASERS. Chinone, N.; Ito, R.; Nakada, O. (Central Research Laboratory, Hitachi, Ltd., Kokubunji, Tokyo 185, Japan). J. Appl. Phys. 47: No. 2, 785-786 (Feb 1976).

Reported here are the results of measurements of several factors limiting the maximum output from GaAs-$Ga_{1-x}Al_xAs$ double-heterostructure injection lasers under continuous operation at room temperature. The factors are (i) catastrophic damage to the mirror facets and (ii) saturation of the output power due to self-heating. Threshold optical density for catastrophic damage is 1.1 MW/cm², and 390 mW is obtained from one mirror of a DH laser with a 80-μ-wide stripe under continuous operation. It is emphasized that DH lasers with a very thin active layer are attractive in order to achieve high-power operation. (auth)

23178 dc-EXCITED AND SEALED-OFF OPERATION OF THE OPTICALLY PUMPED 546.1-nm Hg LASER. Artusy, M.; Holmes, N.; Siegman, A.E. (Microwave Laboratory, Department of Electrical Engineering, Stanford University, Stanford, California 94305). Appl. Phys. Lett. 28: No. 3, 133-134 (1 Feb 1976).

The optically pumped Hg laser at 546.1 nm, first developed by Djeu and Burnham, has now been operated as a sealed-off rather than continuously flowing system, and with dc-excited rather than rf-excited pump lamps in both elliptically focused and close-wrapped configurations. Laser power outputs of ~1 mW cw have been obtained with ~100 W excitation into two commercial Hg germicidal lamps, and a power output of >3 mW has been obtained from a sealed-off tube with ~300 W into a single low-pressure "Toronto arc" pump lamp. Sealed-off operation appears to be stable and long lived, and substantial further performance improvements are expected. (auth)

23179 cw CO-CS_2, CO-C_2H_2, AND CO-N_2O ENERGY-TRANSFER LASERS. Stregack, J.A.; Wexler, B.L.; Hart, G.A. (Laser Physics Branch, Naval Research Laboratory, Washington, D.C. 20375). Appl. Phys. Lett. 28: No. 3, 137-139 (1 Feb 1976).

cw laser emission has been observed from CS_2 (11.5 μ), C_2H_2 (8 μ), and N_2O (10.6 μ) transitions pumped by energy transfer from vibrationally excited CO in an electric discharge gas-dynamic laser device. Proposed energy-transfer pathways for these three lasers are described. Supersonic expansion cooling plays a critical role in depopulating the lower laser levels in the CO-CS_2 and CO-C_2H_2 systems. Maximum output powers measured for each of these systems are presented. The dependence of output power on the flow rate of the injected laser species is discussed. (auth)

23180 Cd-DIFFUSED $Pb_{1-x}Sn_xTe$ LASERS WITH HIGH OUTPUT POWER. Lo, W. (Research Laboratories, General Motors Corporation, Warren, Michigan 48090). Appl. Phys. Lett. 28: No. 3, 154-156 (1 Feb 1976).

Cd-diffused $Pb_{1-x}Sn_xTe$ ($x \sim 0.13$) diode lasers have been fabricated with cw output powers of 1.25 mW (single mode) and 2.4 mW (total) at 10.6 μm. These power levels are attributed to the low-temperature Cd diffusion, a new method of growing low-dislocation-density crystals, and to a contact resistance as low as 3×10^{-5} Ω cm². Multimode emission spectra are common for cw operation, but reducing the cavity width encourages single-mode emission, indicating the filamentary nature of modes in these devices. (auth)

23181 TUNING OF THE EMISSION FREQUENCY OF SEMICONDUCTOR INJECTION LASERS IN A SELF-CONTAINED LIQUID HIGH-PRESSURE CHAMBER. Anzin, V.B.; Vasin, B.L.; Glushkov, M.V.; Eremets, M.I.; Itskevich, E.S.; Kosichkin, Yu.V.; Nadezhdinskii, A.I.; Poluboyarov, V.N.; Shirokov, A.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Semicond. 9: No. 8, 959-961 (Aug 1975).

The emission frequency of GaAs lasers with one- and two-sided heterostructures was tuned in a small self-contained chamber in which a high pressure was transmitted by a liquid. The room-temperature laser emission wavelength was altered by more than 1000 Å by applying pressures up to 15 kbar. (auth)

23182 He-Ne RING LASER WITH LOCKED LONGITUDINAL MODES. Petrun'kin, V.Yu.; Nikolaev, V.M.; Galkin, S.L. (M. I. Kalinin Polytechnical Institute, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 6, 770-773 (June 1975).

The primary purpose of these experiments on a He-Ne ring laser with locked longitudinal modes at 0.63 μ, is to determine the factors that influence the beat frequency of the oppositely directed waves and to compare the frequency characteristics of phase-locked multimode and single-mode operations. Locking of the longitudinal modes is achieved by modulating the cavity loss at a frequency near the intermode frequency. The experimental results show the advantages of the mode-locked regime over the single-mode regime. In the mode-locked regime the beat frequency is less sensitive to small changes (of the order of thermal changes) in the cavity. The capture band for oppositely directed waves is narrower; in the phase-locked regime this band is governed by back-scattering solely from surfaces near the two spike meeting points. (auth)

23183 PARAMETRIC SOLUTION FOR THE SELF-SYNCHRONIZATION OF THREE MODES. Zeiger, S.G.; Pelyukhova, E.B. (A. A. Zhdanov Leningrad State University). Sov. Phys.—Tech. Phys. 20: No. 6, 774-780 (June 1975).

A solution is found in parametric form for the steady-state generation of three modes with side modes of unequal intensity. An asymmetric three-mode regime arises at pump levels $\alpha_2/\alpha_1 = D_0$, $D^{(2)}_\pi$, $D^{(3)}_\pi$, which determine the phase-stability boundary for symmetric regimes, $E^2_2 = E^2_3$, $\varphi = 0$, π. The instability region for both symmetric regimes lies essentially entirely within the region in which the asymmetric regime exists. At the boundaries at which the asymmetric regime appears, D_0, $D^{(2)}_\pi$, $D^{(3)}_\pi$, this regime coincides with the corresponding symmetric regime, with $\varphi = 0$ or $\varphi = \pi$. Concrete calculations are carried out for the asymmetric regime of a traveling-wave laser with $\gamma = \gamma_{ab}$ and for a standing-wave laser with $\gamma = \gamma_{ab}$ and $\gamma = 0.2\gamma_{ab}$. The pump region in which the asymmetric regime exists in the case of small mode spacings lies above the boundary for the appearance of this regime, $D_0 = \alpha_2/\alpha_1$. At large mode spacings the asymmetric regime is not single-valued: To each pump level there correspond two or three asymmetric regimes with $E_2 + E_3$. The asymmetric regime exists not only for pump levels above D_0 or $d^{(2)}_\pi$: but also in a small pump range below D_0, $D^{(3)}_\pi$: $\alpha_2/\alpha_1 > D_{min}$, where $D_{min} < D_0$ ($^*D_{min} < D^{(3)}_\pi$. (auth)

23184 STABILITY OF AN ASYMMETRIC THREE-MODE REGIME. Zeiger, S.G.; Pelyukhova, E.B. (A. A. Zhdanov Leningrad State University). Sov. Phys.—Tech. Phys. 20: No. 6, 781-784 (June 1975).

A region of stability is found in an analysis of the stability of a three-mode regime with unequal side-mode intensities, $E^2_2 \neq E^2_3$, with a symmetric arrangment of frequencies within the amplification spectrum, $\Omega_1 = \omega_{ab}$, $\omega_{ab} - \Omega_2 = \Omega_3 - \omega_{ab}$. This regime is stable only for sufficiently large mode spacings $\Delta\omega/\sqrt{\gamma\gamma_{ab}} > f_s$ near the boundary for its appearance, $\alpha_2/\alpha_1 = D_0$. For $\Delta\omega$ not too large, the range in which the asymmetric three-mode regime is stable lies within the instability region for both symmetric three-mode regimes, $\varphi = 0$, π; $E_2 = E_3$. At large mode spacings these regions coincide in a traveling-wave laser, so that at least one steady-state, stable generation regime exists for any pump level. At large values of $\Delta\omega$ in a standing-wave laser the region in which the asymmetric regime is stable lies outside the instability region for the symmetric regimes. When there are several asymmetric solutions in a traveling-wave laser there is only one stable solution—that corresponding to the maximum energy ratio $E_2^2 + E_3^2/E_1^2$ for the given pump level and to the minimum asymmetry $E^2_2 - E^2_3/E^2_1$. In a standing-wave laser with $\Delta\omega/\sqrt{\gamma\gamma_{ab}} < f^*$, both asymmetric solutions are stable. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstract 24276.

23185 (BNL-18762) BNL MATERIALS RESEARCH FOR AN AC SUPERCONDUCTING POWER TRANSMISSION CABLE. Gurinsky, D. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1 Apr 1974. 36p. (CONF-740448-1). Dep. NTIS $5.00.

From program exchange for Brookhaven and USSR transmission line work meeting; Washington, District of Columbia, USA (8 Apr 1974).

The program on materials which was performed to improve the superconductors for ac superconducting power transmission applications is described. The conclusions previously reached concerning the superconductor for ac power transmission was that the A-15 superconductor Nb_3Sn showed the greatest promise of meeting the requirements for a transmission cable since it had a high critical temperature, critical current and critical field. These properties permit higher operating temperatures (6 to 8°K) with lower refrigeration costs and single phase He cooling.

The high critical temperature is also desirable to cope with fault conditions which may arise in an operating transmission line. The ac loss measurements on commercial Nb_3Sn superconductor tapes fall in the range of 50 to 100 mu W/cm^2 at currents of 500 A/cm at 4.2°K. Although designs for a cable could be made with this level of losses, it was decided that an objective of the materials program should be the reduction of these losses by a factor of 2 to 4. The program which followed continued the evaluation of available commercial Nb_3Sn tapes and special tapes from commercial producers; in addition a metallurgical study was made of the factors which might contribute to losses in commercial tapes. Original methods were developed to fabricate tape and cylindrical specimens for ac loss measurements. (auth)

23186 (CONF-740767-P1) APPLICATION OF HIGH MAGNETIC FIELDS IN SEMICONDUCTOR PHYSICS. Lectures Presented at the International Conference, Wuerzburg, Germany, July 24–August 2, 1974. Part I. (Wuerzburg Univ. (F.R. Germany). Physikalisches Inst.). 1974. 808p. Wuerzburg Univ., Germany.

Forty papers were presented at the conference. Part I contains thirty-five papers. A separate abstract was prepared for each of two papers. The remaining thirty-three papers are not in the subject scope of NSA. (TFD)

For abstracts of individual papers see: 23147 and 23187.

23187 (CONF-740767-P1, pp 761-795) ADVANCES IN HIGH FIELD MAGNET TECHNOLOGY. Henning, C. D.; Swartz, P. S.; Rosner, C. H. 1974.

From international conference on the application of high magnetic fields in semiconductor physics; Wuerzburg, Germany, German, Federal Republic of (F.R. Germany) (24 Jul 1974).

In application of high magnetic fields in semiconductor physics. Part I.

A brief history of the development of superconductors for magnets is followed by a discussion of high-field applications, which include studies in nuclear magnetic resonance, the DeHaas–Van Alfen effect, magneto optics, solid state physics, and plasma physics. A discussion is given of high-field superconducting materials having potential for technological applications and the stability of high-field superconductors, one of the principle limitations of their use. The future of superconducting magnet technology is projected. (PMA)

23188 (CONF-740767-P2) APPLICATION OF HIGH MAGNETIC FIELDS IN SEMICONDUCTOR PHYSICS. Lectures Presented at the International Conference, Wuerzburg, Germany, July 24–August 2, 1974. Part II. (Wuerzburg Univ. (F.R. Germany). Physikalisches Inst.). 1975. 136p. Wuerzburg Univ., Germany.

Forty papers were presented at the conference. Part II contains five papers. A separate abstract was prepared for one paper. The remaining four papers are not in the subject scope of NSA. (TFD)

For an abstract of an individual paper see: 23189.

23189 (CONF-740767-P2, pp 37-63) LIQUID NITROGEN COOLED MAGNETS. Brechna, H. (Federal Inst. of Tech., Zurich). 1975.

From international conference on the application of high magnetic fields in semiconductor physics; Wuerzburg, Germany, German, Federal Republic of (F.R. Germany) (24 Jul 1974).

In application of high magnetic fields in semiconductor physics. Part II.

The theory, construction, operation, and uses of cryogenic magnets cooled by liquid nitrogen are reviewed. (TFD)

23190 (ERDA-tr-80) TESTING AND OPERATION OF HELIUM LOW-TEMPERATURE INSTALLATIONS FOR APPLIED SUPERCONDUCTIVITY. Katheder, H.; Lehmann, W.; Spath, F. (Kernforschungszentrum Karlsruhe (F.R. Germany)). 1974. Translation of KFK-EXT-3/74-9. (CONF-740451-25). 26p. Dep. NTIS $5.00.

From conference on solid state physics; Freudenstadt, F.R. Germany (1 Apr 1974).

At the Institute, two large He II refrigerators are used for research work in the field of superconductivity. The execution and results of the acceptance tests and the problems encountered during utilization and operation of the refrigerators is reported. For proving the specifications extensive tests were carried out. The measured capacity at 1.8°K was higher than the guaranteed value. Special attention was given the He tightness (leak rate less than 20 Nl/h) and the oil-free condition of the compressors was carefully checked. The refrigerator built by Linde delivers 380 W and has been operated about 10,000 h since 1971. The machine built by the firm Messer Griesheim delivers 350 W and was put into normal operation in 1974.

23191 (FE-1227-1) MHD PHENOMENA AT HIGH MAGNETIC FIELDS. Interim Technical Report, July 1972–December 1974. Eustis, R. H.; Self, S. A. (Stanford Univ., Calif. (USA). Dept. of Mechanical Engineering). Feb 1975. 13p. (FE-1739-1). Dep. NTIS $3.50.

The design study for an 8T superconducting magnet for MHD research at Stanford University is briefly described. The design parameters for an 8 tesla solenoid are listed. (WHK)

23192 (LA-6215-PR) DC SUPERCONDUCTING POWER TRANSMISSION LINE PROJECT AT LASL. USERDA Division of Electric Energy Systems Progress Report No. 11, July 1–September 30, 1975. Keller, W. E.; Taylor, R. D. (comps.). (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1976. Contract W-7405-eng-36. 27p. Dep. NTIS $5.00.

The eleventh progress report of the Los Alamos Scientific Laboratory dc Superconducting Power Transmission Line (SPTL) Development Project covers the period July 1 to September 30, 1975. Geometric, mechanical, and electrical design of a dc SPTL using multifilamentary Nb_3Sn wires is analyzed assuming power levels of 1000 to 10,000 MW. (auth)

23193 RESEARCH INSTITUTE OF L'HYDRO-QUEBEC. Ingenieur (Montreal); 56: No. 260, 18-22(Nov 1970). (In German)

The Electrochemical Division carries out studies in the fields of production, distribution and sale of electric energy. This covers problems connected with fuel cells and batteries, as well as the design of electric cars. The high-power division plans the establishment of a test laboratory with capacitors providing 4 megajoules at 1050 Kv. Continuous three-phase supply of 7200 MVA and synthetic tests allowing a 7-fold equivalent power input are planned. The Division of Material Sciences carries out research on cable and transformer oils with particular attention to the relationship between the mechanism of the dielectric and the molecular structure. The division of mechanics and thermodynamics is concerned with overhead lines, cryogenic systems and thermal problems in the design of electric equipment. Applications of plasma physics for the generation, transport and utilization of electric energy forms the main line of the Basic Sciences Division.

23194 CRYOGENIC POWER TRANSMISSION. Minnich, S. H.; Fox, G. R. (General Electric Co., Schenectady, NY). pp 43-67 of Low Temperatures and Electric Power. Pergamon Press; Oxford (1970).

From International Inst. of Refrigeration conference; London, England (24 Mar 1969).

A detailed study has been carried out on cryogenic underground electric power transmission using conventional conductors in liquid nitrogen and hydrogen, and hydrogen, and superconductors in liquid helium. The dielectric properties of liquid N_2 and H_2 are discussed with respect to their advantages in high voltage cables, and design methods to overcome skin effect are also discussed. Superconducting systems for ac transmission were also studied, and the use of niobium to reduce losses is described. The use of vacuum insulation and free liquid helium in low-voltage cables is also mentioned, and it is shown that at present there is no economic justification for use of superconducting compared with conventional cables.

23195 FUTURE TRENDS IN CRYOELECTROTECHNICS (FOR POWER GENERATION AND TRANSMISSION). Fabre, J. (Electricite, Paris). pp 441-445 of Low Temperatures and Electric Power. Pergamon Press; Oxford (1970).

From International Inst. of Refrigeration conference; London, England (24 Mar 1969).

Applications of very low temperatures to the components of large electrical generation and transmission networks in terms of probable evolution in the next twenty years are reviewed. Taking as an example the French network, where generation is in the provinces and a major part of the electrical consumption is concentrated in the Paris region, it is seen that one of the main applications may be that of dc or ac cryo-connections in relation to improvements that may be made in controlling ac losses and in the technology of cryogenic substructures. However, other interesting applications may be envisaged for generating stations where the use of superconducting inductors may enlarge the range of unitary power available at the moment. Owing to their large scale, projects for energy storage in superconducting coils are more hazardous. Finally, machines employing transition processes between the normal and superconducting states need considerable improvements from the material point of view in order that they may achieve future industrial potential. A comparative study of the evolutions in technology and in living matter shows that a choice is necessary to avoid dissipating research efforts towards projects doomed to failure.

23196 PROBLEM OF SUPERCONDUCTIVE AC POWER TRANSMISSION. Zuev, E. N. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 1, 45-54(1971). (In Russian)

An evaluation is made of the various possible systems, and the electrical and geometrical characteristics of the superconductive transmission of large amounts of power. Methods are given for calculating the basic design characteristics of the lines with coaxial current carrying conductors, taking into account a number of technical constraints, and especially the conditions for the static stability of the transmission. Optimal relations are discussed between the power to be transmitted and the conditions for the preservation of the super conductivity, as well as of the transmission stability. (auth)

23197 BASIC WAYS OF REDUCING THE COSTS OF CRYOGENIC POWER TRANSMISSION LINES. Litver, V. E.; Okolotin, V. S. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 1, 55-63(1971). (In Russian)

Western literature is cited that indicates that the extra expenses for superconductive transmission is mainly in the initial costs of installing the cryogenic shielding and the refrigerating equipment. The initial costs are seen to be optimal in the case of about equal cost of sheathing and equipment. Two economically optimal designs of thermal insulation are discussed. (auth)

23198 DESIGN CONCEPTS OF SUPER INSULATED PIPES FOR SUPERCONDUCTING CRYOGENIC ELECTRIC POWER CABLES. Eigenbrod, L. K.; Long, H. M.; Notaro, J. (Union Carbide Corp., Tonowanda, NY). J. Eng. Ind.; 93: No. 4, 1152-1160(Nov 1971).

23199 SUPERCONDUCTING CABLE FOR TRANSMITTING HIGH ELECTRICAL CURRENTS. Kafka, W. (to Siemens AG). US Patent 3,529,071. 15 Sep 1970. Priority date 29 Apr 1967, German, Federal Republic of (F.R. Germany). vp.

The cable includes an electrically non-conductive refrigerant tube which has its interior partly filled with a liquid refrigerant which occupies the lowermost interior portion. A superconductor extends along the interior of the refrigerant tube in the lower interior portion and is at all times completely submerged within the liquid refrigerant. The superconductor is fixed within the refrigerant tube in a manner substantially preventing any movement of the superconductor with respect to the refrigerant tube while at the same time providing for substantially unobstructed movement of vapor bubbles of the refrigerant from the superconductor outwardly through the liquid refrigerant to a space within the refrigerant tube located over the liquid refrigerant.

23200 HIGH-CURRENT AC LOSSES IN LARGE SUPERCONDUCTING NIOBIUM TUBES. Meyerhoff, R. W.; Beall, W. T. Jr. (Union Carbide Corp., Tarrytown, NY). J. Appl. Phys.; 42: No. 1, 147-153(Jan 1971).

Loss measurements were made at 60 Hz on 6 m lengths of 1 and 3 cm-diam superconducting niobium tubes used as the inner conductor of a coaxial line. These tubes carried transport currents up to 1700 and 5300 ^{0}A, respectively. The ac losses showed a 25 percent linear increase with temperature from 4.2 to 5^{0}K. For the case of an eccentric coaxial line, where the current and magnetic field vary about the circumference of the superconductor, the ac losses were found to agree with those predicted from calculated values of the current and magnetic field distributions.

23201 INSULATION SYSTEMS FOR CRYOGENIC CABLE. Jefferies, M. J.; Mathes, K. N. (General Electric Co., Schenectady, NY). IEEE Trans. Power Appar. Syst.; PAS-89: No. 8, 2006-2014(1970).

The measured dissipation factor and breakdown strengths of certain dielectric materials impregnated with cryogenic liquids suitable for cryogenic cable application are presented. The separate and combined influence of different factors which affect dielectric loss and breakdown strength is discussed.

23202 CONCEPTUAL DESIGN AND ECONOMIC ANALYSIS OF A SUPERCONDUCTING AC POWER CABLE SYSTEM. Eigenbrod, L. K.; Long, H. M.; Notaro, J. (Union Carbide Corp., Tonawanda, NJ). IEEE Trans. Power Appar. Syst.; PAS-89: No. 8, 1995-2005(1970).

The experimentally measured ac losses in superconducting niobium of a size and shape suitable for practical power cables have been shown to be of such small magnitude that ac superconducting cables warrant serious consideration. Design criteria are established for three phase cables employing shielded tubular niobium conductors with compressed helium dielectric. These criteria are then used in an economic analysis of cable systems operating at utility system voltages. The results indicate that such superconducting cables should offer substantial economic benefits when used for the underground transmission of blocks of power in the one to ten gigawatt range.

23203 DESIGN FEATURES OF AC SUPERCONDUCTING CABLES. Long, H. M.; Notaro, J. (Union Carbide Corp., Tonawanda, NY). J. Appl. Phys.; 42: No. 1, 155-162(Jan 1971).

Alternating current superconducting cables which can be rapidly integrated into utility systems require both a superconductor with low characteristic ac losses and a high-performance cryogenic system to minimize the cost of heat pumping the thermal losses to the atmosphere. Moreover, the resulting cable systems must operate with the long-term reliability expected of utility systems. Recent publications have treated the measurement of the superconducting material properties and the conceptual electrical and cryogenic design for a superconducting cable. The present authors discuss a cable configuration and examine its electrical and cryogenic design features with principal emphasis placed upon the relationship of these features with present technological capabilities. Fabrication and installation feasibility and the expected levels of performance and reliability can be inferred from the practical operating cryogenic systems which are used as a guide for the selection and design of the cryogenic enclosure for the cable.

23204 COUPLING SYSTEM FOR CRYOGENIC vhf RESONATORS. Knyasev, B. R.; Zykov, A. I. (Physical-Technical Inst., Kiev). Cryogenics; 13: No. 7, 436(Jul 1973).

The device described for coupling a transmission line to a cooled vhf resonator enables the coupling to be tuned in any part of the resonator and does not require a mechanical system for adjusting the coupling.

23205 SIMPLE GLASS DEWAR FOR HIGH RESOLUTION MICROSCOPIC OBSERVATIONS OF MAGNETO-OPTICAL PHENOMENA AT LIQUID HELIUM TEMPERATURES. van Kempen, H.; Mischgofsky, F. H.; Wyder, P. (Katholieke Univ., Nijmegen, Netherlands). Rev. Sci. Instrum.; 43: No. 8, 1209-1210(Aug 1972).

A simple glass Dewar setup for high resolution microscopic observations of magnetooptic phenomena at liquid helium temperatures is described. The light is guided via a light pipe system into the Dewar. The observations are made using a microscope with objective lenses with a working distance of a few millimeters placed outside the Dewar. Resolutions of the order of 1 mu were obtained.

23206 PROGRESS IN CRYOGENIC CABLE DIELECTRICS. Jefferies, M. J.; Mathes, K. N. (General Electric Research Development Center, Schenectady, NY). pp 153-163 of 1969 Annual Report Conference on Electrical Insulation and Dielectric Phenomena. Washington, DC; National Academy of Science (1970).

From conference on electrical insulation and dielectric phenomena; Bucks Hill Falls, PA, USA (20 Oct 1969).

Both low resistance and superconducting, high voltage cable, cooled with cryogenic liquids, offer the possibility for transmitting very large amounts of power. The cryogenic liquids by themselves or as impregnants for paper or paper-like materials may be used as the dielectric system for such cryogenic cable. Some of the dielectric properties of nitrogen and hydrogen, as pure liquids and as impregnants for paper, and Du Pont's TYVEK polyethylene paper, are described.

23207 COAXIAL LOW-TEMPERATURE COMMUNICATION CABLES. Hahne, K. H. Draht-Welt; 58: No. 4, 207-214(Apr 1972). (In German).

The application of low-temperature techniques to communication cables has been examined in detail, with emphasis on the utilization of superconductivity. It is shown that the application of these techniques creates new possibilities if, instead of superconductivity temperatures, only moderately low temperatures of the order of 20^{0}K are used. Cables having considerably smaller dimensions, manufactured from less expensive materials, show at such temperatures, compared with regular cables, superior electrical properties. Suitable manufacturing facilities are described. (auth)

23208 FIELD TEST OF LIQUID NITROGEN COOLED CRYOGENIC POWER CABLE. Nagano, H.; Fukasawa, M.; Kuma, S.; Sugiyama, K. (Hitachi Cable Ltd., Ibaraki, Japan). Cryogenics; 13: No. 4, 219-223(Apr 1973).

A liquid nitrogen cooled cryogenic cable, 66 kV, 100 MVA, 30 m was constructed and tested with loads simulating actual operating loads. The stable operating of the cooling system under various load tests, resistance to deterioration and general good performance, indicate the cable could possibly be used for large capacity transmission. The test line is fabricated with aluminum stranded hollow conductor, liquid-nitrogen impregnated polyethylene paper electrical insulation, and polyurethane foam thermal insulation. (auth)

23209 TRANSMISSION FORCES TO A CRYOSTAT. Glanese, P.; Porrot, E.; Rey, G.; Taguet, B. (Centre d'Etude Nucleaire, Grenoble, France). Cryogenics; 13: No. 9, 550-553(Sep 1973).

The mean thermal conduction between 4 to 77°K and 4 to 300°K and the elastic modulus were measured in compressive stress for some pure and glass fiber reinforced plastics. The thermal and mechanical properties of fiberglass plastics depends on the orientation of the fiberglass with respect to the applied force. The materials can be classified by means of the ratio: elastic modulus-mean thermal conduction, and can be used in a cryostat to resist large forces with small thermal losses and small displacements. (auth)

23210 THEORETICAL ANALYSIS OF THE DISCHARGE OF A SUPERCONDUCTING INDUCTIVE ACCUMULATOR TO A PARALLEL INVERTOR. Bertinov, A. I.; Ionova, A. S.; Manuilov, V. G. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 5, 151-153 (1974).

Energy stored in a superconducting winding is discharged through an invertor circuit. The process is analyzed mathematically. (auth)

23211 APPLICATIONS OF SUPERCONDUCTIVITY. Goodman, B. B. (British Oxygen Co., London). Postepy Fiz.; 24: No. 4, 731-791(1973). (In Polish).

The most important application at present is the use of Type II superconductors to produce large static (or slowly time dependent) magnetic fields for use in research, in novel types of electrical machinery and possibly in magnetically levitated trains. Secondly, superconductivity is of interest in two types of applications which do not specifically require high fields, linear accelerators and power cables. Finally, the Josephson effect is leading to the development of electronic devices with unique properties of sensitivity and accuracy. Technological factors outside superconductivity are outlined and the possibility of an industry based on superconductivity is discussed. (auth)

23212 LOW TEMPERATURE COAXIAL TELECOMMUNICATION CABLES. Hahne, K. H. Wire World Int.; 14: No. 6, 234-240(1972).

Cryogenic techniques have been developed to a high status. Their application in power cables has been seriously investigated centering on the utilization of the effects of superconductivity. In telecommunication cables, especially carrier frequency cables and antenna feeders the utilization of cryogenic techniques already opens new ways when using only moderately low temperatures of the order of 20°K rather than superconductivity temperatures. Cables of considerably smaller size made of less expensive materials like aluminium of technical purity instead of copper under such temperatures have superior electrical properties compared to normal cables. Manufacturing facilities and suitable designs are shown to be readily available. (auth)

23213 BRIDGE MEASUREMENT OF VERY LOW DIELECTRIC LOSS AT LOW TEMPERATURES. Nelson, R. L. (Central Electricity Research Lab., Leatherhead, Eng.). Proc. Inst. Electr. Eng. (London); 121: No. 7, 764-770(Jul 1974).

A Schering Bridge, the associated apparatus and the techniques used for the determination of very small values of loss tangent at power frequency, low electric stress and liquid helium temperatures are described. The loss tangents of several small samples of polyethylene and polytetrafluoroethylene have been measured to be less than 10^{-5} radians. At 4.2°K liquid helium was used as the loss reference. It is proposed that this method is also suitable for measuring the dielectric loss of large samples.

23214 LONG DISTANCE HEAVY POWER TRANSMISSION BY MICROWAVES. Paul, H. Bull. Schweiz. Elektrotech. Ver.; 60: No. 14, 609-621(5 Jul 1969). (In German).

Having discussed the most suitable types of waves, their damping and the power carrying capacity, the deformation and problems due to the geometry of the line and other causes, having considered the cost of transmission, it is concluded that, at least from the technical point of view, the microwave transmission of large amounts of power is possible. Transmission on superconductive cable is also briefly treated and the means for re-converting the microwave energy for various consumer application are reviewed.

23215 CRYOGENIC CABLE DIELECTRICS. Mathes, K. N. IEEE Trans. Electr. Insul.; EI-4: No. 1, 2-7(Mar 1969).

In the search for cable designs capable of transmitting larger blocks of power, consideration has been given to replacing oil in the oil/paper cable with liquified gases. The evaluation of liquid hydrogen as the substitute for oil is discussed. The system is not operated at the superconducting region but at higher temperatures. Not only cellulosic paper but synthetic papers and films were evaluated. The results were very encouraging.

23216 TOTAL ENERGY TRANSFER SYSTEM FOR LNG AND ELECTRICAL POWER. Pastuhov, A.; Ruccia, P. (Arthur D. Little, Inc., Cambridge, MA). Cryog. Ind. Gases; 4: No. 3, 14-18 (Mar 1969).

The concept and economics of concurrent LNG (Liquid Natural Gas) and superconducting cable power transmission are discussed. LNG, liquid hydrogen, and helium temperature and superconducting methods are summarized together with associated sections and diagrams.

23217 SOME ENGINEERING LIMITATIONS OF SUPERCONDUCTORS IN POWER TRANSFORMERS, POWER CABLES, AND MACHINES. Wilkinson, K. Jr. (Associated Electrical Industries Ltd., Rugby, Eng.). Nature (London); 219: No. 5161, 1317-1319 (28 Sep 1968).

The use of superconductors for handling electrical power is still limited by the refrigeration involved and problems to do with high magnetic fields at the conductor. Copper, therefore, still holds its advantage.

23218 USE OF SUPERCONDUCTIVITY: A PROMISING DIRECTION TOWARD SOLVING THE MAJOR PROBLEMS OF ELECTRIC POWER. Mikhnevich, G. V.; Blinkov, E. L.; Gol'denberg, E. S. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 6-13(1972). (In Russian).

The historical background, present position, and future possibilities of electric power applications of superconductivity are discussed in general terms.

23219 SUPERCONDUCTIVITY AND ITS APPLICATIONS. Murthy, N. S. N.; Krishnaswami, N. V.; Ameerjan, S. Electr. India; 10: No. 12, 56-58(Dec 1970).

The main advantages of the superconducting motors are very good power/weight ratio which is advantageous in industrial applications; the motor has high efficiency so that it is ideal in high-power, low-speed applications; and the motor occupies much less space than an equivalent conventional motor. Since there are virtually no upper limits on size, the motor is attractive for large marine drives, and for power-station auxiliaries and steel mills. Regarding the magnetic flux as constant, the torque is proportional to the rotor current, which can be controlled independently. Thus the speed can be controlled over a wide range by varying the rotor current.

23220 SOME PROBLEMS OF SUPERCONDUCTING COAXIAL TRANSMISSION LINES. Migunov, L. V. Izv. Vyssh. Uchebn. Zaved., Radioelektron.; 14: No. 5, 581-582(May 1971). (In Russian).

Analysis of losses in superconducting coaxial lines indicate that the dielectric losses in the fluoroethylene are commensurate with the losses in superconducting transmission lines at frequencies 7 to 9 GHz; at lower frequencies, the losses in the dielectric predominate, when tan delta = 3×10^{-6} at 4.2°K. The effect of dielectric losses on line parameters is studied theoretically. As an example, the response of a coaxial line, 2000 m long, using niobium and lead with fluoroethylene filling, has been calculated for two cases, with and without dielectric losses.

23221 PRESENT STATE AND TENDENCIES IN THE EVOLUTION OF THE TECHNIQUE OF HIGH CURRENT SUBTERRANEAN CABLES IN THE FEDERAL REPUBLIC OF GERMANY. Wanser, G. Rev. Electrotec.; 55: No. 4, 157-177(Jul 1969). (In Spanish).

An introduction indicates the growth of electrical power consumption in large industrialized countries over the last forty years and the relation of this to distribution and distribution costs. These costs are shown to be so high that the transmission of energy is a major problem. Details of the treatment of this problem in Germany since the war are presented. Details are given of various cables employed together with illustrations of these. The practical behavior of cables with paper and thermoplastic insulation is discussed, with details such as deformation by heat, resistance to mechanical damage and corrosion, and inflammability. Some details are given of thermoplastic cables with sodium conductors. Following this, high voltage oil and gas-filled cables are described. Finally, details are given of the construction of superconducting cables.

23222 PRINCIPLES AND LIMITATIONS OF ELECTRIC POWER TRANSMISSION. Oeding, D. Polytech. Tijdschr. Elektrotech. Elektron.; 26: No. 15, 575-586(21 Jul 1971). (In Dutch).

Due to the increasing demand for electric power, it will be necessary in the future to transmit very high power from generating stations to the largest take-off points. According to current views, three phase engineering with high tension lines and cables will be capable of solving the main problems of transmission in the years to come. On economic grounds, higher voltages will also be applied for relatively short distances. In special cases, more use will be made of the method of transmitting high tension dc, particularly for covering large distances with high tension

lines, transmission by underground and sea cables, for improving the stability in three phase systems by parallel operation of high tension three phase and dc lines, for coupling asynchronous systems and (if necessary and economically justified) for limiting the short circuiting current. To meet the future requirements, the methods of transmitting by high tension three phase and dc current will have to be developed further. New high tension insulations, improved electrical equipment and protective gear as well as suitable coordination of insulations may very well contribute effectively towards this. Cables with superconductors, highly cooled cables or SF_6 tubular cables will ultimately be used besides conventional three phase and dc cables only where no more routes for high tension lines are available. The current level of technology suggests that SF_6 tubular cables will be applicable before superconducting cables.

23223 SUPERCONDUCTING CABLES FOR AC TRANSMISSION. Bogner, G.; Schmidt, F. (Siemens AG, Erlangen, Ger.). Elektrotech. Z., A; 92: No. 12, 740-745(Dec 1971).

A survey is given of a number of proposed cable configurations with special reference to an arrangement whereby each phase conductor is surrounded by a coaxial return conductor. A description is given of the major cable components for the implementation of a superconducting ac. Taking the data already available at present for a 110 kV, 2500 MVA cable as a basis, the authors illustrate that, for transmission powers of 2.000 MVA and above, low transmission losses and reduced plant and equipment costs are expected as compared with other underground transmission systems.

23224 ECONOMY OF SUPERCONDUCTING DC CABLES. Ihara, S.; Horigome, T. Electr. Eng. Jpn. (Engl. Transl.); 91: No. 3, 91-98(1971).

A comparison study is made on the economy of three dc power cables; the conventional, superconducting, and low-temperature power cables. The installation cost and the ten-year operating cost are calculated for both superconducting and liquid-hydrogen cables.

23225 OPTIMUM DESIGN OF CRYOGENIC CURRENT LEAD USING CRYOSTAT LOSS. Shimamoto, S. Electr. Eng. Jpn. (Engl. Transl.); 93: No. 1, 1-6(1973).

The geometrical size of the current lead at the optimum conditions as a function of the cryostat loss in the case of ideal heat exchange is obtained. The geometrical condition is obtained as a function of heat exchange. Further, the relation between the gas flow and the temperature distribution is measured using the experimental current lead of braided copper. The measured results are compared with the calculated results. It is shown that the current lead in the case of nonideal heat exchange with the cryostat loss can be designed by the method proposed in this paper.

23226 SUPERCONDUCTIVE ELECTRIC CABLE. Klein, G. (to Campagnie Generale d'Electricite). US Patent 3,414,662, 3 Dec 1968. Priority date 10 Nov 1965, France. vp.

This application describes cable construction, including a cable core comprising a stacked alternate arrangement of conductive bands and insulating bands. The stack is supported within a duct carrying a cryogenic fluid capable of contacting directly at least portions of the conductors. Surrounding the fluid-carrying duct, is a thermally insulating envelope. The individual conductors of each stack carry current in a direction opposite to the current flowing in the two conductors adjacent thereto so that the resultant field generated is maintained below the critical value at which the superconductive properties of the conductor may be undesirably affected by this field. Direct currents as well as alternating and multi-phase currents may also be advantageously transmitted by this cable.

23227 FLEXIBLE SUPERCONDUCTING POWER CABLES. Forsyth, E. B.; Blewett, J. P.; Britton, R. B.; Garber, M.; Gurinsky, D. H.; Hendrie, J. M.; Jensen, J. E.; Morgan, G. H.; Powell, J. R. (Brookhaven National Lab., Upton, NY). IEEE Trans. Power Appar. Syst.; PAS-92: No. 2, 494-505(1973).

In view of the fact that installation costs may represent up to half the investment in an underground cable system, it is desirable to develop concepts for superconducting cables which, from the beginning, promise to keep this expense to a minimum. Superconducting cable will be very light and, providing it is flexible, the cable should be capable of being pulled in long lengths. Two concepts for flexible superconducting cables are presented together with a discussion of expected performance in the system.

23228 ZERO-VOLTAGE NONDEGENERATE PARAMETRIC MODE IN JOSEPHSON TUNNEL JUNCTIONS. Pedersen, N.F. (Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark). J. Appl. Phys. 47: No. 2, 696-699 (Feb 1976).

A new parametric mode in a Josephson tunnel junction biased in the zero-voltage mode is suggested. It is a nondegenerate parametric excitation where the junction plasma resonance represents the input circuit, and a junction geometrical resonance represents the idler circuit. This nondegenerate mode has been observed in analog experiments. In a real junction the realization of this mode of operation depends on the coupling between the plasma resonance and the geometrical resonance, and it is argued that without an external dc magnetic field the even geometrical resonances are most favorable for such a coupling. (auth)

23229 THE SUPER-SCHOTTKY DIODE MICROWAVE MIXER. McColl, M.; Pedersen, R.J.; Bottjer, M.F.; Millea, M.F.; Silver, A.H.; Vernon, F.L. Jr. (Electronics Research Laboratory, The Aerospace Corporation, El Segundo, California 90245). Appl. Phys. Lett. 28: No. 3, 159-162 (1 Feb 1976).

Superconductor-semiconductor (super-Schottky) diodes fabricated from Pb on *p*-GaAs have been extensively studied as microwave mixers. The measured performance at *X*-band is 9-dB conversion loss and 1.6 K diode noise temperature, resulting in a mixer noise temperature of 13 K. This result is in good agreement with theory and represents a major advance in low-noise frequency conversion. (auth)

23230 INCREASED DEMANDS FOR ELECTRICITY REQUIRES CONTINUOUS RESEARCH. Electra (Rijswijk); 51: No. 22, 12-16(1 Jun 1971). (In Dutch)

The increased rate of electricity consumption, plant construction and improved quality of supplies in Holland, and also the advantage of using grid reserves are discussed. Since 1950, average unit sizes have increased tenfold to outputs of 500 MV. A higher voltage (380 kV) national grid has had to be built, but despite increased operation costs the price per kV has stayed unaltered for the last 50 years due to increased usage and technical improvements. Future increases in output seem dependent on metallurgical developments making higher temperature steam generation possible. Cable costs may be reduced by use of superconductors. Better results are expected from nuclear energy units in future.

Heat Transfer and Fluid Flow

Refer also to abstracts 25192, 25256, and 25291.

23231 (AECL-5257) BUBBLING FROM SUBMERGED ORIFICES. D'Arcy, D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1975. 49p. (CONF-7509114-1). Dep. NTIS (US Sales Only) $4.00. AECL $1.50.

From meeting of American Institute of Chemical Engineers; Boston, Massachusetts, United States of America (USA) (8 Sep 1975).

Bubbling is an important mechanism in the flow of gas through the liquid bed on a sieve tray. Published experimental and analytical results on bubble flow characteristics are analyzed. It is found that a few basic relations and parameters describe the majority of the published experimental results and provide a basis for predicting bubble volume and frequency under given conditions. (auth)

23232 (K-1864) TWO-PHASE FLOW PRESSURE DROP AND HEAT TRANSFER CHARACTERISTICS OF REFRIGERANTS IN VERTICAL TUBES. Jallouk, P. A. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 579p. Dep. NTIS $14.75.

Research was undertaken to study the two-phase flow characteristics of refrigerants in vertical tubes. An experimental study was made of the flow regime, pressure drop, heat transfer coefficient, and critical heat flux of R-114 boiling in a 0.785-in.-ID, 10-ft-long vertical tube. The boiling temperature was varied in the range of 100 to 250°F for all tests except the heat transfer coefficient runs where the range 100 to 200°F was studied. The mass flux range was 0.12 less than or equal to G less than or equal to 3.5×10^6 lbm/hr-ft^2. Analytic and experimental techniques were used to investigate the heat transfer and pressure drop characteristics. An improvement in the prediction of the system behavior was obtained and the discrepancies between the behavior of boiling refrigerants and other working fluids have been explained. New equations were developed or existing ones verified so that design engineers requiring information on the two-phase flow characteristics of refrigerants in vertical tubes at operating conditions not too different from those studied here may use the equations presented here. The limitations of each equation are also presented. Recommendations for further investigation are given. (auth)

23233 (NSPM-5) HEAT TRANSFER AND PRESSURE DROP IN SPACE RADIATORS. Kardys, C. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). May 1960. 33p. Dep. NTIS $4.00.

Heat transfer and fluid flow relationships capable of rapid solution on either digital computer or desk calculator are pro-

vided. Heat transfer relationships are developed for fins, tubes, and a fin-tube combination exposed to solar radiation. A condensing flow pressure drop relationship is also developed. Most of the relationships are approximate. However, they give results close to those obtained by rather unwieldy exact methods, which are unsuitable for economical parametric studies. (auth)

23234 (RD/B/N-3252) DESIGN AND OPERATION OF A SMALL (BENCHTOP) PUMPED SODIUM LOOP. Trevillion, E. A.; Rowe, D. M. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1975. 22p. Dep. NTIS (US Sales Only) $3.50.

The design and operation of a small (benchtop) pumped sodium loop (sodium, 650 g) are discussed. The loop incorporates a diffusion cold trap to control the oxygen impurity level in the sodium and a sodium sampler/distillation unit to enable sodium samples to be analysed for impurities. Sodium flow rates of up to 5.5. cm/s (1 cm^3/s) have been achieved at temperatures up to 673.2°K (400°C) and temperatures of up to 1023.2°K (750°C) have been achieved under static conditions. A device for the addition and removal of metallic specimens to and from the loop sodium without contamination of either the specimens or the sodium is also described. (auth)

23235 DETERMINATION OF HEAT TRANSFER TO SUPPORT PLATES OF TUBE NESTS. Dagsoz, A. K. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). Rev. Gen. Therm.; 14: No. 162, 495-499(Jun 1975). (In French)

In order to study the stresses to which the support plates of tube nests are submitted, an attempt was made to determine the heat transfer coefficient between the circulating gas and a single plate. The test carried out with a wooden model is described, and a relation between Pr, Nu, and Re is given. A comparison is made of the transfer occurring during a turbulent flow along a flat wall with transfer occurring during the flow along smooth tubes. (FR)

23236 HEAT EXCHANGERS. Fundamentals. Ody Sacadura, J. F. pp 213-244 of Course on Heat Transfer. Lecture Proceedings. Lyon, France; Institut National des Sciences Appliquees (1973). (In French) (Institut National des Sciences Appliquees (INSA), 69-Villeurbanne (France)).

A study was made of heat exchangers, limited to the case of simple conventional heat exchangers, and excluding phase change exchangers and liquid metal exchangers. The principal types of baffles used in tubular heat exchangers, the various types of flow, and the corresponding temperature distributions are briefly reviewed. Two methods for the thermal study of an exchanger are examined: (1) the logarithmic mean of the temperature difference, T(LM); and (2) the N(TU) method (N(TU) = the number of heat transfer units). (FR)

23237 IMPROVEMENT OF HEAT TRANSFER DURING STEAM CONDENSATION ON HORIZONTAL TUBES USING ORGANIC COMPOUNDS ORIGINATING DROPWISE CONDENSATION. Niezborala, J. M. (Institut National des Sciences Appliquees (INSA), 69-Villeurbanne (France)); Huyghe, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). Inf. Aerolique Therm.; No. 42, 3-29 (1974). (In French)

A method of improving the heat exchange of a horizontal condenser tube is presented. A dropwise condensation on the outer wall of the tube is obtained by injecting a fluorinated organic product in the water vapor to be condensed. The experiments were carried out at different vapor pressures between atmospheric pressure and 50 torr. In all cases, dropwise condensation led to an appreciable increase in the condensation heat transfer coefficient, by a factor 6 to 3 according to the working pressure, with respect to the value obtained by film condensation. These figures correspond to an improvement of about 40% in the thermal efficiency of a horizontal condenser tube. This method of injecting a droplet condensation initiator into the water vapor thus lowers considerably the investment cost of a condenser by decreasing its exchange surface. It was calculated that, in the case of a distillation type seawater desalination plant, the use of this process would reduce the cost of the fresh water produced by 10 to 15%. (FR)

23238 NEUTRON RADIOGRAPHY AT LUCAS HEIGHTS. Wall, T.; Gillespie, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). At. Energy Aust.; 18: No. 3, 7-12(Jul 1975).

The technique of neutron radiography is reviewed and differences between it and x-ray radiography are discussed. Practical applications are described. (AT)

23239 THEORETICAL AND EXPERIMENTAL STUDY ON THE VACUUM DEGREE IN THE AREA OF SUBCOOLED BOILING. Gianola, M.; Lavagno, E. (Politecnico di Torino (Italy)). Energ. Elettr.; 51: No. 7, 380-388(1974). (In Italian).

The comparison between a set of vacuum degree measurements carried out at a pressure of 60 Kg/cm^2 in a heated circular conduit and the results of the most known calculation models in the area of sub-cooling boiling are presented. In particular, compared are the correlations for determining the starting point of steam formation and those proposed for the sliding ratio between the two phases. (INIS)

23240 EXPERIMENTAL SURVEYS OF VACUUM DEGREE IN A HEATED VERTICAL CANAL. Lavagno, E. (Politecnico di Torino (Italy)). Energ. Elettr.; 51: No. 6, 332-338(1974). (In Italian)

The results of vacuum degree measurements carried out, by utilizing the gamma attenuation technique, on a uniformly heated vertical canal, in which a two-phase mix flows at a pressure of 60 Kg/cm^2, are presented. Measurements were carried out with a flow of 0.3 Kg/s, equal to a specific flow of 1179 $Kg/s\ m^2$ for three values of the thermal flow: 253-295-338 $KCal/s\ m^2$. Values of α have been obtained in the subcooling upper and lower areas and in the first part of the saturated area. (INIS)

23241 DIFFERENTIAL EQUATIONS FOR INVESTIGATION OF RADIATION HEAT TRANSFER BETWEEN COAXIAL CYLINDERS BY AN ABSORBING-EMITTING MEDIUM WITH HEAT SOURCES. Rekin, A.D. (P. I. Baranov Central Scientific-Research Institute for Aviation Motor Construction). High Temp. 13: No. 3, 526-531 (May 1975).

Exact direction-averaged differential equations are obtained for radiation transfer in an infinitely long cylindrical layer. The resultant radiant flux and the sum of the hemispherical radiant fluxes are used as the variables in the equations. Valid simplifications are derived for the equations found and analytic solutions of the latter are obtained for monochromatic radiation in cases of high and low optical density of the medium between the cylinders. (auth)

Materials Testing

Refer also to abstract 22727.

23242 (HEDL-SA-1004A) INFRARED ELECTRO-THERMAL NDE OF STAINLESS STEEL. Green, D. R.; Hassberger, J. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 18 Jul 1975. Contract E(45-1)-2170. 28p. (CONF-751016-5). Dep. NTIS $4.00.

From conference of the American Society for Nondestructive Testing, Inc.; Atlanta, Georgia, USA (13 Oct 1975).

Electro-thermal examination, a branch of thermal testing, is a promising method being developed for nondestructive examination of stainless steel welds. This paper describes the first phase of development; i.e., preliminary demonstration and laboratory evaluation of the method's sensitivity to notches in Type 304 stainless steel plate specimens. It also includes a description of the basic principles, together with a description of the hardware and experimental results showing that electrical discharge machined notches down to 0.16 cm long x 0.08 cm deep were detected. A qualitative technique for interpreting the test results to determine whether defects are at the surface or deeper within the material is demonstrated. (auth)

23243 (RARDE-4/75) IMAGE QUALITY IN NEUTRON RADIOGRAPHY. Halmshaw, R. (Royal Armament Research and Development Establishment, Fort Halstead (UK)). Feb 1975. 19p. Dep. NTIS (US Sales Only) $3.50.

The limitations and characteristics of the technique of thermal neutron radiography developed in RARDE, using a 5-MV Linac and the (X,n) reaction in beryllium, were determined quantitatively using MTF values obtained for various converter screens. The effective source-size was determined to be from 80 to 90 mm dia at 840 mm source-to-detector distance, and the implications of this large diameter on the choice of suitable converter screens are detailed. It is shown that with a small diameter neutron source, neutron radiographs of image sharpness similar to radiographs taken with 150 kV x-rays are possible; with the present equipment the image sharpness is no better than is obtained with gamma-rays from ^{60}Co and in most practical applications will be far worse than on any conventional x- or gamma-radiographs. (auth)

23244 ADJUSTABLE NEUTRON SOURCES. Lauthier, J. C.; Marin, J. F. (to CEA, 75-Paris (France)). French Patent 2,233,683/A/. 15 Jun 1973. 10p. (In French)

Description is given of a method for adjusting the intensity of the neutron emission of an α-emitter source. The amount of oxygen isotope 18 in the α-particle emitting material is caused

to increase or decrease. This can be applied to chemical, biological or metallurgical analyses. (FR)

Nuclear Explosions

Refer also to abstracts 23822 and 25329.

23245 (PB-240933) REACT USER'S GUIDE. Final Report. (General Services Administration, McLean, Va. (USA). Mathematics and Computation Lab.). Feb 1975. 71p. (GSA/OP/MCL-TM-251). NTIS $4.25.

The REACT query package is an interactive damage prediction system for use during and following a nuclear attack. It provides senior decision makers with quick access to selected data about the status of critical resources relative to the weapon detonations that have occurred. The relatively simple English-like language used for entering queries negates the need for subject matter specialists having knowledge of computers. (GRA)

23246 (UCRL-Trans-10669) USE OF NUCLEAR EXPLOSIONS IN UNDERGROUND ORE RECOVERY. Imenitov, V. R.; Evstropov, N. A.; Baranov, A. O. Translated from Gorn. Zh.; No. 12, 33-36 (Dec 1973). 11p. Dep. NTIS $3.50.

Published Soviet and foreign projects on the use of underground nuclear explosives for crushing ore deposits are reviewed and analyzed. (LCL)

23247 (UCRL-Trans-10928) PREVENTION AND ELIMINATION OF OIL AND GAS BLOWOUTS. Igrevskii, V. I.; Mangushev, K. I. Sep 1975. Translated from pp 131-189 of Predupreizhdenie i Likvidatsiya Neftyanyikh i Gazovykh Fontanov, Nedra Press, Moscow, 1974. 97p. Dep. NTIS $6.00.

A detailed report and analysis is given of a runaway blowout of well 1P in the Pionerskoe oil field in the USSR. After the failure of all known methods of stopping blowouts, an evaluation was made of using an underground nuclear explosion to shut off the shaft at a great depth. The methods used for the determination of the position of the shaft, drilling of the inclined wells for the placement of the nuclear explosives, and the concluding work after stopping the blowout are described in detail. A similar analysis was made of a blowout in the Molodezhnoe field. The steps in the formulation of a program for the elimination of blowouts are discussed and the factors leading to the selection of an underground nuclear explosion are examined. (JSR)

Protective Structures and Equipment

23248 (DPSPU-75-30-15) RESPIRATORY AND PROTECTIVE EQUIPMENT AT A LARGE NUCLEAR FACILITY. Zippler, D. B. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Dec 1975. Contract AT(07-2)-1. 15p. (CONF-760403-1). Dep. NTIS $3.50.

From conference on control of hazardous material spills; New Orleans, Louisiana, United States of America (USA) (27 Apr 1976).

A variety of personal protective equipment is used in a large nuclear facility to protect employees against both nuclear and ordinary industrial materials. Equipment requirements are based on risk evaluation and may range from a minimum of shoe covers to whole body protection by air-supplied plastic suits. Types of equipment are listed and one-year costs are given. Criteria for evaluating and compartmentalizing risks are discussed. Air-supplied suits and hoods are discussed in detail. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Refer also to abstract 23880.

23249 (ANL-75-3(Pt.3), pp 19-31) DISTRIBUTION OF AMORPHOUS, DIATOM FRUSTULE, AND DISSOLVED SILICA IN A LEAD-210 DATED CORE FROM SOUTHERN LAKE MICHIGAN. Robbins, J. A.; Edgington, D. N.; Parker, J. I. 1974. In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Measurements were made of ^{210}Pb and amorphous, diatom, and dissolved silica in the same sediment core in order to assess the effect and significance of dissolution of frustule silica and to compare regeneration of interstitial silica from biogenic phases with contributions from solution of clay minerals. Methods for obtaining cores and analyzing samples for silica are described. Graphs are presented to show distribution of porosity, total ^{210}Pb, and amorphous, diatom frustule, and dissolved silica in cores and other data. (HLW)

23250 (CEA-R-4709) APPLICATION OF ELECTRONIC MICROSCOPY TO THE STUDY OF FINE ATMOSPHERIC AEROSOLS. Butor, J. F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Jan 1976. 92p. (In French). Dep. NTIS (US Sales Only) $5.00.

Thesis. Submitted to Brest Univ., France.

In order to specify size properties and nature of atmospheric aerosols, a method allowing the study of both Aitken nuclei and mean particle ($8.5.10^{-3} < d < 2\ \mu m$) was chosen. An Anderson impactor collecting bigger dust particles and a downstream nuclepore filter were used. Deposits were studied with a transmission electron microscope. Apparatus, collecting and analysis methods are described. Particle size distribution was formulated mathematically and the experimental results allowed to determine the characteristics of the materials used (Anderson impactor and the nuclepore filter collection efficiency). Finally, the nature of the aerosols observed at Brest, Ouessant or in the Atlantic Ocean off Azores was studied and statistical analysis was made of particle size distribution in various places with various meteorological conditions. (auth)

23251 (PB-239790) TRANSPORT PROCESSES OF PARTICLES IN DILUTE SUSPENSIONS IN TURBULENT WATER FLOW, Phase III. Research Report. Jones, B. G.; Howard, N. M.; Meek, C. C.; Tomkins, J. (Illinois Univ., Urbana (USA). Water Resources Center). Dec 1974. Contract DI-14-31-0001-3582. 110p. (UILU-WRC-74-0091). NTIS $5.25.

Understanding the basic mechanisms and predicting the behavior of particles suspended in turbulent fluid flow are essential to environmental conservation and to multiphase system design. Air and water pollution, sedimentation and erosion of riverbeds and coastal shorelines, and atmospheric fallout are some of the areas in which particle suspensions are of key importance. Detailed experimental measurements of dilute particle suspensions have been performed which examined the effects of particle size, shape and relative density on the statistical response of such particles in a turbulent fluid. Shape was found to be of minor importance for spheres, cubes and tetrahedrons. However, size was found to be important when the particle dimension was as large or larger than the fluid turbulence structure. Relative density influenced both free fall and inertial effects. An analytical model was developed which included these latter effects. It agrees well with observed particle dispersion measurements. (GRA)

23252 (TID-26941) BIBLIOGRAPHY OF REPORTS BY U. S. GEOLOGICAL SURVEY PERSONNEL ON THE NEVADA TEST SITE AND RELATED SUBJECTS, JULY 1, 1974 TO JUNE 30, 1975, WITH AUTHOR AND SUBJECT INDEXES. Ohl, J. P. (Geological Survey, Denver, Colo. (USA)). 1975. Contract AT(29-2)-474. 35p. Dep. NTIS $4.00.

The following bibliography includes reports issued between July 1, 1974, and June 30, 1975, by personnel of the U. S. Geological Survey on the Nevada Test Site and related subjects and areas. A special feature of this bibliography is a partial list of USGS-474 series reports (USGS-474-153 through USGS-474-221) showing those reports in the series that have been issued since the last bibliography or their present status if still in preparation. Cross references to show the alternative designation of these reports in the various administrative series are listed. Reports numbered in the USGS-474 series are usually made available to the public through NTIS (U. S. Department of Commerce. National Technical Information Service, Springfield, VA 22161), and may be purchased at $2.25 per microfiche copy; hard copies of the reports released since March 10, 1973, are prices at $4.00 for 1-50 pages, $5.45 for 51-150 pages, $7.60 for 151-325 pages. An index map shows the area of the Nevada Test Site as it is divided into $7\frac{1}{2}$-minute quadrangels; a second map of the Nevada Test Site shows how it is divded into numbered areas. The area of the Central Nevada Test Area, divided into 15-minute quadrangels, is shown and the locations of sites B, C, D, E, and F on Amchitka Island Supplemental Test Site are shown. (auth)

Minerals and Ores

23253 (AED-CONF-75-337-001) MEDIUM- AND LONG-TERM SUPPLY OF THE FRG WITH NATURAL URANIUM. Stephany, M. (Koeln Univ. (F. R. Germany). Inst. fuer Energierecht). 1975. 21p. (In German). INIS.

From 44th colloquium on problems of energy legislation; Koeln, F. R. Germany (22 May 1975).

Available from ZAED.

The present situation of uranium supply is described with the main parameters prices, quantities, and availability. The influence of the different reactor types on the uranium demand is discussed. Considering all the important factors, the long-term supply of the FRG with natural uranium seems to be assured. (DE)

23254 (GJO-109(76-1)) SURVEY OF LANDS HELD FOR URANIUM EXPLORATION, DEVELOPMENT, AND PRODUCTION IN FOURTEEN WESTERN STATES IN THE SIX MONTH PERIOD ENDING JUNE 30, 1975. (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Dec 1975. Contract AT(05-1)-1664. 32p. Dep. NTIS $4.00.

Tabulated data are presented on land distribution by ownership, distribution by states, distribution by land category, and land control by county and state. (JSR)

23255 (PB-241629) SELECTED BIBLIOGRAPHY PERTAINING TO URANIUM OCCURRENCE IN EASTERN NEW MEXICO AND WEST TEXAS AND NEARBY PARTS OF COLORADO, OKLAHOMA, AND KANSAS. Interim Report. Finch, W. I.; Wright, J. C.; Sullivan, M. W. (Geological Survey, Denver, Colo. (USA)). 1975. 100p. (USGS-GD-75/003). NTIS $4.75.

Nearly 500 selected references to uranium and to stratigraphy, structure, and groundwater geology related to uranium-bearing formations in eastern New Mexico and West Texas and nearby parts of Colorado, Kansas, and Oklahoma are indexed topically and geographically. The list is nearly complete through 1972 and contains some references with later dates. (GRA)

23256 CHEMICAL PROCESSING OF NODULES WITH A VIEW TO AN INDUSTRIAL EXPLOITATION. Faugeras, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). pp 1-18, pt.B × 207 of 2nd International Colloquium on the Exploitation of Oceans. Vol. 4. Exploration at Great Depths. Valorization of Fish Products. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]). (In French)

From 2nd international colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

Considering 3 criteria: content of valuable metals in nodules, sale prices, and present and future state of the metal market, constituents of nodules are classed into various kinds. The most interesting elements and the valuable products are then defined. All possible processing methods are examined, principally the hydrometallurgical ways, and a small number of processes are selected. Their advantages and disadvantages are analyzed. One of the selected processes is studied from an economic point of view: investment and processing costs and freight charges. The opportunity of obtaining a concentrated product near the mixing place is examined. As a conclusion, the conditions are defined which are necessary for a processing scheme to provide profits. (FR)

23257 MINE WORKING IN THE SEA USING THE AIR-LIFT PUMPING PROCESS. Jacquemin, J. P.; Lapray, J. F.; Porte, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service d'Etudes Energetiques). pp 1-10, pt.B × 204 of 2nd International Colloquium on the Exploitation of Oceans. Vol. 4. Exploration at Great Depths. Valorization of Fish Products. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]). (In French)

From 2nd international colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

Very many materials can be exploited, ranging from sand gravel to polymetallic nodules and located at depths between 0 and 6000 m. Their low value per ton means that extraction and transport operations strongly affect the cost price. Under these conditions a research and development effort is necessary, centered on a particularly suitable mining technology. In this paper the CEA research program and work on the "air lift" pumping process applied to mine working in the sea are described. (FR)

23258 NUCLEAR EUROPEAN COOPERATION AND NATIONALIZATION. Lescuyer, G. Rev. Droit Public Sci. Polit.; No. 2, 379-398(Mar 1975). (In French)

A discussion is given of the creation of the Societe Centrale Nucleaire Europeenne a Neutrons Rapides (NERSA) on December 23, 1972, which authorizes enterprises exerting European interests in electricity on national ground. The question of whether denationalization will result rather than European cooperation is discussed, a problem which raises the more general problem of the future of public enterprises in France. (FR)

23259 ANALYTIC PROFILE OF THORIUM AND RARE EARTHS. Maciel, A. C.; Cruz, P. R. Bulletin No. 28. Rio de Janeiro; Ministerio das Minas e Energia (1973). 79p. (In Portuguese).

Information international in scope concerning Th, rare earths, and monazite and its associated minerals was compiled to assist the Brazilian government in setting policy with respect to these substances and to provide private business with data on which to base investment decisions. Much detail was drawn from unpublished internal reports of Brazilian government agencies. Geology, mineralogy, technology, production, consumption, trade, economic factors, applications and miscellaneous other topics are covered by means of text, tables, charts, maps, statistics and flow sheets. Specific to Brazil is information of present government policy, the structure of the processing industry, domestic markets, the production of materials for nuclear energy applications, the volume of known reserves of Th, rare earths, monazite, ilmenite, zirconite and rutile, locations of deposits of these materials and potential sources of monazite. (Metals Abstr.)

23260 ANALYTIC PROFILE OF URANIUM. Maciel, A. C.; Cruz, P. R. Bulletin No. 27. Rio de Janeiro; Ministerio das Minas e Energia (1973). 77p. (In Portuguese).

Information about U and the U industry throughout the world was compiled to assist the Brazilian government in setting policy with respect to this material. Much detail was drawn from internal reports prepared by geologists of Brazil's National Commission on Nuclear Energy and from unpublished papers of various origin. The geology of U deposits, applications of the U, the structure and economics of the industry, international production and demand and miscellaneous other topics are covered by means of text, tables, charts, maps, statistics and flow sheets. Specifics for the Brazilian scene include a description of the principal occurrences of U, methodology of prospecting, volume of both known reserves and potential sources, history of government activity in prospecting and summary of prospecting work planned for the near future. (Metals Abstr.)

23261 REVIEW OF PROBLEMS ASSOCIATED WITH THE UTILIZATION OF AVAILABLE THORIUM RESOURCES. O'Hara, F. A. (Ohio State Univ., Columbus); Gray, R. A. Nucl. Mater. Manage.; 4: No. 3, 545-556(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Portions of the U. S. Thorium Stockpile are in danger of literally "going to waste." These raw materials, with their high concentrations of thorium, are valuable resources which can be utilized to fuel thermal converter reactors. A portion of this stockpile was transferred to Mound Laboratory in the early 1950's. In 1972, the material was determined to be excess to all present and foreseeable future national requirements. Disposal by burial was recommended by the AEC. Following a detailed study of the potential usefulness of the material and the costs associated with land burial, the AEC agreed to offer the material on surplus sale. Risks and benefits associated with retention of the thorium stockpile are described. Nuclear Materials Managers are uniquely situated to exercise influence and direct the future course of remaining thorium reserves. (auth)

23262 FUTURE FOR URANIUM. Barnes, C. H. Nucl. Mater. Manage.; 4: No. 3, 542-544(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Uranium resources, exploration, and production (both domestic and foreign) for meeting the demand in U. S. are discussed briefly. (DLC)

23263 MECHANISM OF REPLACEMENT OF URANINITE BY SECONDARY MINERALS. Sidorenko, G. A.; Dubinchuk, V. T.; Kopchenova, E. V. Sov. At. Energy (Engl. Transl.); 38: No. 2, 137-139(Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 105-107(Feb 1975).

An electron microscopic study was made of the natural formations described previously as nenadkevite, which are essentially a mixture of the alteration products of uraninite, in order to determine the nature of the changes in uraninite during natural oxidation. It was observed that uraninite develops either only uranium hydroxides or silicates and hydroxides simultaneously. The development of the hydroxides was followed from a coalescence of the single globules into dendritic accumulations, which subsequently form large crystals of uranyl hydroxides. The neocrystalline minerals were highly dispersed. (JSR)

Radioactivity Monitoring and Transport

Refer also to abstracts 23293, 23294, 23304, 23321, 23341, 23373, and 23560.

23264 (AECL-5309, pp 27-49) ENVIRONMENTAL RESEARCH BRANCH. Ophel, I. L. Nov 1975.

In Biology and Health Physics Division progress report, July 1–September 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.).

Studies of primary productivity in lake water receiving heated water discharge have been carried out at the Maskinonge Lake experimental facility. Emphasis was placed on studies of the bacterial population responses to temperature variations in the aquatic environment. The effects of heated effluent on the St. Lawrence River to the area downstream of the LaPrade Heavy Water Plant were studied. A detailed study of sub-surface contamination in the Chalk River Nuclear Laboratories Solid Waste Management Area showed that ^{137}Cs and ^{60}Co were found in many soil samples in low concentrations. The distribution of deuterium, oxygen-18, and tritium in the ground waters of the east side of the Perch Lake drainage basin was studied. Tritium and deuterium in water in the St. Lawrence River were used as tracers to study the mixing of river water with seawater at the surface and at various depths in the St. Lawrence Estuary. (CH)

23265 (ANL-75-3(Pt.3)) RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIVISION ANNUAL REPORT, JANUARY–DECEMBER 1974. Ecology. (Argonne National Lab., Ill. (USA)). 1974. Contract W-31-109-Eng-38. 202p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 26 papers of the report. All were included in ERDA Energy Research Abstracts and 21 were included in Nuclear Science Abstracts. (HLW)

For abstracts of individual papers see: 23249, 23266–23273, 23293–23295, and 23308–23316.

23266 (ANL-75-3(Pt.3), pp 69-71) MIAMI RIVER WATERSHED PROJECT: INTRODUCTION. Muller, R. N.; Sprugel, D. G.; Edgington, D. N. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

The Miami River watershed in southwestern Ohio is described with regard to temperature, precipitation, topography, soils, vegetation, hydrology, and industry. The distribution of ^{238}Pu, ^{239}Pu, and ^{240}Pu is discussed. (HLW)

23267 (ANL-75-3(Pt.3), pp 72-77) PLUTONIUM CONCENTRATIONS IN WATER AND SUSPENDED SEDIMENT FROM THE MIAMI RIVER WATERSHED, OHIO. Bartelt, G. E.; Wayman, C. W.; Edgington, D. N. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Plutonium concentrations were investigated to identify sources and sinks of Pu in the watershed and to determine spatial and temporal variability in concentrations of the different isotopes and the range of ^{238}Pu: $^{239+240}Pu$ ratios. Results are reported from 12 sites on the Miami River above and below Mound Laboratory, the local ^{238}Pu source, as well as at four sites on tributaries of the river. (HLW)

23268 (ANL-75-3(Pt.3), pp 78-86) PLUTONIUM IN AQUATIC BIOTA OF THE GREAT MIAMI RIVER WATERSHED, OHIO. Wayman, C. W.; Bartelt, G. E.; Edgington, D. N. 1974.

In Radiological and Environmental Research Division annual

report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Methods for collection and preparation of biological samples are described. Radiochemical analysis for ^{238}Pu, ^{239}Pu, and ^{240}Pu was performed on an alga, Cladophora sp., a vascular plant, Potamogeton sp., goldfish, carp, and other fishes. Results showed that concentration of Pu by algae and macrophytes was 10^2 to 10^3 that of fish, excluding the gastrointestinal tract and its contents. An average of 80 percent of ^{238}Pu in carp was associated with the gastrointestinal tract and contents. The levels of ^{238}Pu in Cladophora were a function of the distance from the release site. (HLW)

23269 (ANL-75-3(Pt.3), pp 87-88) MIAMI RIVER WATERSHED PROJECT: TERRESTRIAL STUDIES. Sprugel, D. G.; Muller, R. N.; Edgington, D. N. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Soil samples were collected at one to five miles from the laboratory to determine the distribution of ^{238}Pu around Mound Laboratory. Fractionation studies of soils were initiated to determine the distribution in the soil relative to particle size. Gross movement of ^{239}Pu in the Miami River watershed is being monitored through analysis of suspended sediments and filtered water samples. (HLW)

23270 (ANL-75-3(Pt.3), pp 89-96) CHEMICAL SPECIATION OF $^{239,240}Pu$ AND ^{137}Cs IN LAKE MICHIGAN WATERS. Alberts, J. J.; Wahlgren, M. A.; Jehn, P. J.; Nelson, D. M.; Orlandini, K. A. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Studies of the submicron size distribution and charge characteristics of naturally occurring levels of ^{239}Pu, ^{240}Pu, and ^{137}Cs were conducted to help define the physico-chemical state of these fallout derived nuclides in Lake Michigan waters and in precipitation samples taken in the Argonne Laboratory area. Procedures are described for sample collection, size distribution determination, analysis of ion exchange resins, and plutonium determination by evaporation. Results indicated that the radioisotopes exist in several different fractions within the water column and that the total charge of these fractions is different from what would be predicted by simple solution chemistry. The distribution of the isotopes in snow appears to be different from that in the water column, indicating that considerable chemical or physical transformations must take place after the atomospheric input has reached the lake surface. (HLW)

23271 (ANL-75-3(Pt.3), pp 97-102) EFFECT OF MUNICIPAL TREATMENT PROCESSES ON $^{239,240}Pu$ AND ^{137}Cs. Alberts, J. J.; Jehn, P. J.; Nelson, D. M.; Marshall, J. S.; Wahlgren, M. A. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Studies were conducted to investigate the role of municipal water and waste treatment on ^{239}Pu, ^{240}Pu, and ^{137}Cs in Lake Michigan. Results show that a far greater quantity of ^{239}Pu, ^{240}Pu, and ^{137}Cs are impinged on the metropolitan area of Chicago than is supplied through the drinking water system. The ratio of $^{137}Cs/^{239,240}Pu$ in Lake Michigan water is 86, while that of the material coming out the filtration plant is 95. The increase in ratio indicates the greater efficiency of removal of Pu over that of Cs. Atmospheric ratios of Cs to Pu are approximately 60, while the ratio in the organic fertilizer is 50. It appears that very little Pu is reaching the public through the drinking water source. (HLW)

23272 (ANL-75-3(Pt.3), pp 103-112) SEDIMENTARY $^{239,240}Pu$ PHASE DISTRIBUTIONS IN LAKE MICHIGAN SEDIMENTS. Alberts, J. J.; Wahlgren, M. A.; Reeve, C. A.; Jehn, P. J. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

The study was conducted on sediment samples obtained along a transect in the Grand River and extending into deep water of Lake Michigan. Procedures are described for total ^{239}Pu and ^{240}Pu determinations by acid extraction; ^{239}Pu and ^{240}Pu determinations for magnesium chloride fractions; ^{239}Pu and ^{240}Pu determinations for citrate-dithionate fractions; ^{239}Pu and ^{240}Pu determinations for NaOH fractions; ^{239}Pu and ^{240}Pu determinations for fusion fractions; and fulvic acid vs. humic acid distribution of sedimentary ^{239}Pu and ^{240}Pu. Results indicated that ^{239}Pu and ^{240}Pu concentrations were low in all samples and that ^{239}Pu and ^{240}Pu in sediments were relatively immobile and none was in the form of refractory particles. (HLW)

23273 (ANL-75-3(Pt.3), pp 113-127) DISTRIBUTION OF PLUTONIUM IN LAKE MICHIGAN SEDIMENTS. Karttunen, J. O.; Edgington, D. N. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

A study was conducted to obtain baseline information as to the present content of Pu in sediment from Lake Michigan, to determine the utility of Pu isotopes for estimating sedimentation rates, to assess the extent of additional radionuclide inputs to Lake Michigan from nuclear power plants and other sources, and to determine the vertical distribution in recent sediments. Tables are presented to show sedimentation rates and calculated mixing depths, flux normalization factors, and total activity of ^{239}Pu, ^{240}Pu, ^{137}Cs, and ^{210}Pb in sediment cores taken in 1972, 1973, and 1974. Graphs are presented to show measured ^{137}Cs, ^{239}Pb, and ^{240}Pu profiles in sediment cores and sedimentary columns at various stations during 1972, 1973, and 1974. The significance of the results is discussed. (HLW)

23274 (BNWL-1937) RADIONUCLIDE CYCLING IN A UTAH DAIRY FARM. Thomas, J. M.; Eberhardt, L. L.; Hawthorne, H. A.; Zellmer, S. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Jan 1976. Contract E(45-1)-1830. vp. Dep. NTIS $9.00.

Both detailed and summarized data are presented for ^{137}Cs and for ^{90}Sr which resulted from a study of the deposition of fallout radionuclides into a Utah dairy farm. In addition, mathematical models and statistical methods (including nonlinear least-squares techniques) were used to obtain estimates of key parameters for a compartmental model of the dynamics of ^{137}Cs transfers in the dairy system. Both the results of laboratory studies and field observations were used to derive the estimates and to construct functional relationships for the model. Two computer models were used to further analyze and evaluate consistency of the fallout-alfalfa-milk sequence of data. The results of this study are compared with two similar investigations (in Colorado and Michigan) and are used to examine earlier analyses of the general system studied. Extensive data tabulations are also presented. (auth)

23275 (CEA-CONF-3121) DILUTION FACTOR OF RADIOACTIVE CONTAMINATION IN THE DISTRIBUTION PATHWAYS OF DIETARY PRODUCTS. Garnier, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 3p. (CONF-750518-12). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

The evaluation of irradiation levels in a population which might result from ingestion of contaminated foods is often based on the hypothesis of consumption of local products. This practice is justified for the evaluation of the maximal possible risk to individuals or to small special groups of the population. In other cases, such as collective dose evaluations, it is necessary to take into account a dilution factor of the contamination which is incorporated at the stage of agricultural production. This depends on the: collection of raw products from different locations having different contamination levels; industrial processing of the raw products; and marketing processes. The dilution of radioactivity in milk and other dairy products is discussed in detail. (CH)

23276 (CONF-740701-, pp 267-275) DISTRIBUTION STUDIES OF PLUTONIUM IN THE GREAT LAKES. Wahlgren, M. A.; Marshall, J. S. (Argonne National Lab., IL). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

The distribution of residual fallout plutonium in Lake Michigan between water and various trophic levels of the food chain has been studied. Concurrent measurements of the conservative fallout radioisotope ^{90}Sr in the water column are used to estimate the cumulative fallout deposition on Lake Michigan; these data indicate that ca 97 percent of the fallout ^{239}Pu (and ca 94 percent of the fallout ^{137}Cs) presently constitute a sediment reservoir pool. The results of analyses of comparison samples of water, plankton, and fish indicate that the residual fallout ^{239}Pu remaining in the water column has attained a consistent physicochemical form in all 5 Great Lakes.

23277 (CONF-740701-, pp 276-285) DETERMINATION OF PLUTONIUM IN SOILS BY MASS SPECTROMETRY. Storms, H. A.; Carlson, D. C.; Hunter, F. F. (General Electric Co., Pleasanton, CA). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

A procedure is described in which mass spectrometry is utilized for the determination of plutonium in soils. Using this procedure we have measured plutonium isotopic compositions at concentrations as low as 2×10^{-14} grams Pu per gram soil. A thermal ionization source with canoe-shaped rhenium filament is utilized in the mass spectrometer. The plutonium, when loaded onto the filament, is contained in a single Dowex-1 resin bead which is about 350 micrometers in diameter. Concentrating the plutonium within this single bead is a key step in the procedure and produces a relatively clean plutonium fraction. The resin bead also serves as an effective diffusion barrier such that the plutonium is prevented from being removed with the lower boiling impurities. The Pu remains in the bead until the temperature is sufficiently high for efficient production of Pu^+ ions. Plutonium ionization efficiencies as high as 2.5 percent have been measured.

23278 (CONF-740701-, pp 443-458) APPLICATION OF NATURAL AND FALLOUT RADIONUCLIDES TO STUDIES OF SEDIMENTATION IN LAKE MICHIGAN. Edgington, D. N.; Robbins, J. A. (Argonne National Lab., IL). Jul 1974.

From 2nd international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

The feasibility of using natural and artificial radionuclides, specifically ^{210}Pb and ^{137}Cs, for the determination of the rates of accumulation of recent sedimentary layers was studied. These two radionuclides are present in the atmosphere and are transferred to the sediments by two processes, wet deposition at the air/water interface by precipitation scavenging and removal from the water column in association with allochthonous or autochthonous sedimenting particulates. The reactions occurring in the water column may involve, among others, ion exchange with clay minerals, direct incorporation by organisms, and absorption by organic detritus. Sediment cores have been taken at many stations in Lake Michigan, and the profiles of ^{210}Pb and ^{137}Cs determined in each case. The interpretation of these profiles is discussed. (auth)

23279 (CONF-760210-1) INTERACTIONS OF THE NAEG INFORMATION SUPPORT PROJECT WITH OTHER PROJECTS. Pfuderer, H. A. (Oak Ridge National Lab., Tenn. (USA)). 1976. 7p. Dep. NTIS $3.50.

From Nevada applied ecology group plutonium and other transuranics information conference; Las Vegas, Nevada, United States of America (USA) (12 Feb 1976).

In the past year the Information Support Project to the Nevada Applied Ecology Group has interacted with many other research projects on the transuranics and other radionuclides. Group interactions through symposiums, workshops, and responding to search requests have proven to be mutually beneficial. The NAEG Information Support Project will draw on the information resources of the Oak Ridge National Laboratory to produce a bibliography of the radionuclides (other than the transuranics) of interest to the Nevada Test Site. (auth)

23280 THERMAL SPRINGS AND SUPERHEAVY ELEMENTS. Chuburkov, Yu. T.; Lebedev, L. M. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 517-521(1974).

Translated from Radiokhimiya; 16: No. 4, 524-529(1974).

Superheavy elements with Z = 112-115 evidently may have an increased volatility and if they exist on Earth, it is probable that they are concentrated in sodium chloride thermal springs in regions with strong dislocations or without a so-called "granite layer." The region of the Caspian Sea, especially the contemporary hydrothermal ore-forming system at Cheleken, is promising for searches for superheavy elements in the territory of the USSR. The hot springs of California (Selton Sea region), the Red Sea (Atlantic II and Discovery), and New Zealand are also interesting in this respect. (auth)

23281 ESTIMATION OF THE RATE OF EXTRACTION OF RADIONUCLIDES FROM FUSED MINERAL PARTICLES. Prokhorov, V. M.; Kovenya, S. V. Sov. Radiochem. (Engl. Transl.); 16: No. 4, 522-526(1974).

Translated from Radiokhimiya; 16: No. 4, 529-535(1974).

An examination of the mechanisms of the transfer of radionuclides from particles formed in a nuclear explosion into soil solution gives grounds for assuming that the limiting stage which determines the rate of this process is the diffusion of ions inside the particles to their surface. The diffusion coefficients of ^{90}Sr calculated from published experimental data lie within the range of 10^{-17} to 10^{-12} cm^2/sec. Calculations based on literature experimental data eliminated the hypothesis on external diffusion kinetics for the extraction of ^{90}Sr and ^{137}Cs from particles of radioactive slag. We calculated the degree of extraction of ^{90}Sr from particles for a wide range of particle sizes and diffusion coefficients. It was shown that with $D \geq 10^{-16}$ cm^2/sec practically the whole of the activity contained in particles with a radius less than $5 \cdot 10^{-4}$ cm may pass from the crystal lattice into an exchange state within a period between 1 and 5 years. With $D \geq 10^{-14}$ cm^2/sec this refers to particles less than $5 \cdot 10^{-3}$cm. (auth)

Atmosphere

Refer also to abstracts 23335, 23336, and 23338.

23282 (BNWL-1966) INTERRELATIONSHIPS OF CHEMICAL AND PHYSICAL INFORMATION AT QUILLAYUTE, WASHINGTON FOR 1974. Ludwick, J. D.; Fox, T. D.; Thomas, C. W.; Wendell, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1975. Contract AT(45-1)-1830. 21p. Dep. NTIS $4.50.

A large number of radioactive and non-radioactive airborne constituents are being measured continually at our coastal air-reference station located in northwestern Washington State. Important correlations have been observed between many of these materials and also with atmospheric parameters. The apparent relationships between changing concentrations and meteorological parameters are being tested using more thorough techniques of investigation, including back trajectory computer analyses. (auth)

23283 (BNWL-SA-5541) CLEANUP OF RADON INHALATION STUDY EFFLUENTS. Anderson, B. V.; Palmer, R. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1976. Contract E(45-1)-1830. 6p. (CONF-760202-27). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Studies of the effects of inhalation in animals of radon and its daughter products, in progress in the Battelle-Northwest laboratory for several years, have resulted in continuous release to the environment of approximately 300 mu Ci of ^{222}Rn per minute. A recent change in the physical location of these studies to a less isolated area required development of a radon retention system capable of decontaminating 4,000 cubic meters of moist, radon-bearing air per month. Experimental data are reported on radon retention by activated carbon. The data collected were used to design a system for retention of 99percent of the radon leaving an inhalation exposure chamber. A flow diagram, shielding considerations for the carbon beds, and operating characteristics of the proposed system are presented. A successful test of the prototype retention system indicated that 40 cubic meters of air would be decontaminated of radon by one kilogram of PCB (6 x 10 mesh) activated carbon under experimental conditions of 0 +- 2°C and 330 cm/min superficial velocity or 660 cm/min true velocity with 50 percent void. (auth)

23284 (CONF-740701-, pp 144-153) ENVIRONMENTAL BASELINES BY NAA OF TREE-RING SAMPLES. Ricci, E.; Harris, W. F.; Reichle, D. E. (Oak Ridge National Lab., TN). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

A collaborative effort has been made between two ORNL divisions at gaining information about environmental baselines and trace contamination levels in the Oak Ridge–Knoxville area. Instrumental, absolute, multielement neutron activation is currently providing data both on pristine conditions of a century ago and on gradual atmospheric contamination by analysis of rings from trees grown in a relatively unpolluted area and in a city. Experience on absolute NAA at ORNL's High Flux NAA Laboratory is discussed in detail, as well as multielement results corresponding to years 1872-76 (Increment No. 20) to 1968-72 (Increment No. 1), for two cores, on each of two trees studied. Concentrations were determined for 13 elements simultaneously in each of 12 different samples. Results show the great potential of this technique in the determination of environmental baselines and trace contamination levels.

23285 (CONF-740701-, pp 250-266) APPLICATIONS OF GAMMA-RAY SPECTROMETRY IN REAL-TIME ENVIRONMENTAL MONITORING. Heath, R. L.; Dyer, N. C. (Idaho National Engineering Lab., Idaho Falls). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nu-

clear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

The operation of large nuclear installations involves significant inventories of radioactive materials. Effective monitoring of effluent streams to permit evaluation of potential hazards which might result from discharge of radioisotopes is a requirement for safe operation of such facilities. The purpose of this paper is to present a summary of a program being conducted at the Idaho National Engineering Laboratory (INEL) to apply gamma-ray spectrometry to real-time isotopic monitoring of nuclear installations. The application of the lithium-drifted Ge spectrometer in the laboratory for isotopic assay is well established. To apply these techniques to routine on-line isotopic measurements requires the solution of a number of significant problems. These may be summarized as follows: the development of a remote pulse-height analyzer system; the development of adequate methods for analysis of pulse-amplitude spectra to permit isotopic assay and interpretation of results; and determination of basic nuclear decay data requirements for nuclides of interest to insure acceptance of isotopic assay results.

23286 (CONF-740701-, pp 328-343) ENVIRONMENTAL ^{129}I MEASUREMENTS. Brauer, F. P. (Battelle Pacific Northwest Labs., Richland, WA). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Iodine-129 from natural and man-made sources has been measured in the environment. The production of ^{129}I in uranium ores by spontaneous fission and (alpha,n) induced fission was first measured by Purkayastha and Martin. Studier, et al. initiated studies on the ^{129}I content of biological and environmental samples. Their measurements of the iodine concentration and the $^{129}I/^{127}I$ isotopic ratio were done by neutron activation analysis. The various processes which can release ^{129}I to the environment have been summarized by Edwards and co-workers. The principal natural ^{129}I production processes are spontaneous fission of uranium and cosmic-ray-produced spallation reactions with atmospheric xenon. Since the discovery of nuclear fission, man-produced fission reactions have resulted in ^{129}I released to the environment. Radioactive iodine isotopes are produced by nuclear fission in reactors and nuclear weapons testing. Because of its volatility, iodine may be released to the atmosphere during nuclear reactor operation, irradiated fuel separation and nuclear waste handling. Once ^{129}I is released to the environment it becomes a permanent contaminant as a result of its 1.6×10^7 year half-life. Measurement of ^{129}I in environmental samples has been reported by several laboratories. ^{129}I released to the environment can also be used as a tracer for various natural processes. The high analytical sensitivity for ^{129}I by activation analysis permits concentration measurements at levels much below those required for radiation protection.

23287 (PB-241242) RECONNAISSANCE STUDY OF RADIOCHEMICAL POLLUTION FROM PHOSPHATE ROCK MINING AND MILLING. (National Field Investigations Center-Denver, Colo. (USA)). Dec 1973. 106p. NTIS $5.25.

A reconnaissance study of the phosphate mining and milling industry was necessary to investigate the magnitude of radiochemical pollution to receiving waters. This report describes the findings of the study and other related problems associated with processing of phosphate fertilizers, such as air pollution, ground-water contamination, possible deleterious consequences of fertilizer use, effects on other receiving water uses, including shellfish and drinking water supplies, and the use of by-product material in the construction industry. Throughout the report a comparison has been made of reconnaissance sampling results with promulgated radiochemical standards and guidelines. Pollution control and analysis and water quality data are also discussed. (GRA)

23288 RADON PROBLEM IN NON-URANIUM MINES IN FINLAND. Kohlos, H. (Inst. of Radiation Physics, Helsinki). Vuoriteollisuus-Bergshanteringen; 32: No. 2, 90-94, 126(Dec 1974). (In Finnish)

Finland has about 20 nonuranium mines in operation. In 1973 there were about 1300 miners in these mines. In 1972-73 a survey on the concentration of radon and its short-lived daughters in mine air was performed. In some mines, working places were found in which the concentration of radon daughters in the mine air was over 30 pCi/l (0.3 WL), which is the maximum permissible concentration for radon and its daughters in the air used in Finland. The highest concentrations were found in poorly ventilated dead-end drifts. In such areas the highest radon concentration was over 1000 pCi/l in working places and over 3000 pCi/l in an unused drift. Generally, the concentration of radon daughters was very much lower than 30 pCi/l in working places. The most common source of radon in the air was the high radon content of the mine water. (auth)

Water

Refer also to abstract 23879.

23289 ^{90}Sr AND ^{137}Cs CONTENT IN BALTIC WATERS. Trusov, A. G.; Ivanova, L. M.; Zolotukhina, V. S.; Gedeonov, L. I. At. Energ. (USSR); 39: No. 3, 177-182(Sep 1975). (In Russian).

On the basis of observations of ^{90}Sr and ^{137}Cs concentrations, the authors have estimated changes in the average values of these concentrations for several years. It was established that, in general, changes in the ^{90}Sr concentration follow changes in the rate of global fallout of this radionuclide with considerable lag. It is noted that much less ^{137}Cs is contained in the Baltic Sea than ^{90}Sr. This can be explained by the action of sorption processes in fresh water and the inflow of waters of low cesium concentration from rivers. Data on the ^{90}Sr and ^{137}Cs content in the water of the Finnish Gulf are presented. (auth)

23290 ^{90}Sr, ^{137}Cs AND TRITIUM CONCENTRATION IN THE BALTIC SEA IN 1972. Vakulovski, S. M.; Katrich, I. Yu.; Malakhov, S. G.; Rosly, E. I.; Chumishev, V. B.; Shkuro, V. N. At. Energ. (USSR); 39: No. 3, 183-185(Sep 1975). (In Russian).

Data on the distribution of ^{90}Sr, ^{137}Cs, and tritium in the Baltic Sea during June 1972 are presented. Average concentrations in surface waters of the open sea are 0.73 pc/l, 0.9 pc/l and 62 T. E. for ^{90}Sr, ^{137}Cs and tritium, respectively. The total reserve of ^{90}Sr in the Baltic Sea during June 1972 has been calculated to be about 15,000 c. (auth)

23291 BASE FLOW OF THE GLENELG RIVER DERIVED FROM TRITIUM CONCENTRATIONS. Allison, G. B.; Holmes, J. W.; Hughes, M. W. (Commonwealth Scientific and Industrial Research Organization, Glen Osmond, Australia). Aust. J. Soil Res.; 13: No. 2, 159-168(Sep 1975).

Water samples collected during June 1966 from the Glenelg River, Vic., had tritium concentrations that decreased monotonically from 35 T.U. at the headwaters to 6 T.U. just above tidal influence. The dilution of tritium, by base flow, was interpreted to yield estimates of groundwater flow to the river from aquifers into which the river has cut its course. In a lower reach of the river approximately two-thirds of the total discharge of 2900 l sec^{-1} was made up by base flow additions. At a later collection in April 1970 the river was not in such a steady state as it was at the time of the earlier collection. The river was too perturbed for plausible interpretation of the observed tritium concentrations in other than three reaches of the river. Nevertheless the method and technique have general validity in humid and subhumid regions where stream regimes are effluent. (auth)

Ecosystems and Food Cycles

Refer also to abstract 23305.

23292 (CEA-CONF-3118) RETENTION AND ABSORPTION OF FOLIAR APPLIED IODINE AND STRONTIUM ON RYE GRASS AND CLOVER. Angeletti, L.; Levi, E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 4p. (CONF-750518-6). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

Results are reported from studies on the uptake and retention of ^{131}I and ^{85}Sr by aerial parts of rye grass (lolium italicum) and clover (Trifolium album) following application by simulated rain spraying. (CH)

Radiometric Techniques

Refer also to abstracts 23264 and 23412.

23293 (ANL-75-3(Pt.3), pp 32-39) STABLE LEAD GEOCHRONOLOGY OF FINE-GRAINED SEDIMENTS IN SOUTHERN LAKE MICHIGAN. Robbins, J. A.; Edgington, D. N. 1974.

In Radiological and Environmental Research Division annual report, January-December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

In a previous article, it was shown that the vertical distribution of stable lead in the fine-grained sediments of Lake Michigan reflects the history of cultural lead inputs. It was found that the lead distributions in dated cores are quantitatively described by

a universal time-dependent loading or source function which is a linear combination of estimated annual inputs of atmospheric lead derived from the combustion of leaded gasoline and the burning of coal in and around Chicago since about 1800. The existence of such a source function for lead implies that stable lead itself may be used to date sediment cores. Mercury depth profiles in western Lake Erie sediments have shown several horizons which correspond to the development of local industrial use of mercury over the past forty years or so. The construction of the lead source function for Lake Michigan sediments was based on only four lead-210 dated cores. To establish the validity of the source function concept, it is applied to the distribution of lead determined in many cores previously obtained from southern Lake Michigan. (auth)

23294 (ANL-75-3(Pt.3), pp 40-50) GEOCHRONOLOGY OF LAKE MICHIGAN SEDIMENTS: ANOMALIES IN LEAD-210 DISTRIBUTIONS. Robbins, J. A.; Edgington, D. N.; Gustinis, J.; Karttune, J. O. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Measurements are reported on ^{210}Pb, ^{137}Cs, and stable lead in a series of ten cores from southern Lake Michigan. In nearly every core, significant subsurface anomalies occur, showing that nonexponential and presently uninterpretable features are the rule rather than the exception in the fine-grained sediments from southern Lake Michigan. (auth)

23295 (ANL-75-3(Pt.3), pp 128-132) DEVELOPMENTS IN UNDERWATER RADIOTELEMETRY AND PRELIMINARY FISH TRACKING IN THERMAL PLUMES. Prepejchal, W.; Haumann, J.; Spigarelli, S. A. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Studies were conducted on telemetry systems applicable to fish tracking in the vicinity of thermal discharges. The studies served to establish the following system requirements: miniature transmitters capable of being attached to or implanted within fish; operating range of 2 to 3 km at depths of 8 to 10 m for location mode; a useful transmitter life of about 10 days; and multichannel capability for inclusion of environmental and fish physicological sensors. Preliminary results are discussed. (HLW)

23296 (CONF-740701-) PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON NUCLEAR METHODS IN ENVIRONMENTAL RESEARCH, UNIVERSITY OF MISSOURI, COLUMBIA, JULY 29, 30, AND 31, 1974. Vogt, J. R.; Meyer, W. (eds.). (Missouri Univ., Columbia (USA). Coll. of Engineering). Jul 1974. Contract AT(49-7)-3140. 479p. Dep. NTIS $10.60.

Separate abstracts were entered for the 43 items in the conference. Twenty-eight were included in Nuclear Science Abstracts, and all were included in ERDA Energy Research Abstracts. (SFL)

For abstracts of individual papers see: 22713, 23276–23278, 23284–23286, 23297–23301, 23322–23334, 23373, 23605, and 24725.

23297 (CONF-740701-, pp 32-35) DETAILED CHEMICAL AND RADIOMETRIC STUDY OF GEOTHERMAL WATERS AND ASSOCIATED ROCK FORMATIONS, WITH ENVIRONMENTAL IMPLICATIONS. Bowman, H.; Hebert, A.; Wollenberg, H.; Asaro, F. Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Major trace and radioactive element abundances including noncondensible gas contents of hot and cold spring waters from geothermal resource areas in north-central Nevada are being studied. These studies will serve as a baseline for the evaluation of the environmental impact of geothermal resource development. Over 50 elements were looked for by x-ray fluorescence and high precision neutron activation analysis techniques. About 15 elements were usually detected in basic hot waters and substantially more in a single acid pool. Tungsten was unusually high in abundance in the hot waters but not in cold. In two areas, uranium was detected at the level of approximately 2-5 ppB in cold water and not detected in the hot spring waters. Attempts are being made to correlate the uranium hot-cold spring data with measurements of radon and radium in the springs in terms of the minimum age of the hot aquifer and the hot water flow rate.

23298 (CONF-740701-, pp 344-355) USE OF INSTRUMENTAL NUCLEAR ACTIVATION METHODS IN THE STUDY OF PARTICLES FROM MAJOR AIR POLLUTION SOURCES. Gordon, G. E.; Zoller, W. H.; Gladney, E. S.; Greenberg, R. R. (Univ. of Maryland, College Park). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Nuclear methods have been used effectively in the study of particles emitted by a coal-fired power plant and a municipal incinerator. In the coal-fired plant there is appreciable fractionation of only five of the observed elements. By contrast, particles from the incinerator are highly enriched in several trace elements.

23299 (CONF-740701-, pp 356-365) INTERPRETATION OF AEROSOL TRACE METAL PARTICLE SIZE DISTRIBUTIONS. Johansson, T. B. (Univ. of Lund, Sweden); Van Grieken, R. E.; Winchester, J. W. Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Proton-induced X-ray emission (PIXE) analysis is capable of rapid routine determination of 10–15 elements present in amounts greater than or equal to 1 ng simultaneously in aerosol size fractions as collected by single orifice impactors over short periods of time. This enables detailed study of complex relationships between elements detected. Since absolute elemental concentrations may be strongly influenced by meteorological and topographical conditions, it is useful to normalize to a reference element. Comparison between the ratios of concentrations with aerosol and corresponding values for anticipated sources may lead to the identification of important sources for the elements. Further geochemical insights may be found through linear correlation coefficients, regression analysis, and cluster analysis. By calculating correlations for elemental pairs, an indication of the degree of covariance between the elements is obtained. Preliminary results indicate that correlations may be particle size dependent. A high degree of covariance may be caused either by a common source or may only reflect the conservative nature of the aerosol. In a regression analysis, by plotting elemental pairs and estimating the regression coefficients, we may be able to conclude if there is more than one source operating for a given element in a certain size range. Analysis of clustering of several elements, previously investigated for aerosol filter samples, can be applied to the analysis of aerosol size fractions. Careful statistical treatment of elemental concentrations as a function of aerosol particle size may thus yield significant information on the generation, transport and deposition of trace metals in the atmosphere.

23300 (CONF-740701-, pp 430-442) DEVELOPMENT OF METHODS AND INSTRUMENTS FOR ENVIRONMENTAL TRACER STUDIES. Kuusi, J.; Kuoj[illegible]amaeki, R. (Technical Research Centre of Finland, Otaniemi). Jul 1974.

From 2nd international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

A project for developing methods and instruments for environmental tracer studies and for creating the resources for carrying out studies in these fields was started at the Technical Research Centre of Finland at the beginning of 1971. The aim of this paper is to briefly illustrate the methods and instruments used and developed and the experiences obtained in the course of the studies and outline future investigations of the project. The project was started by waste water flow pattern studies in lakes and sea using radioisotope tracers. So far nearly 25 studies have been carried out for industrial and communal plants. Analogously with industrial process studies, studies of hydraulics and dynamics of waste water treatment plants for evaluating and optimizing the operation and construction of the plants were started. Investigation into the use of activable tracers has also been started in order to study more long term phenomena than is possible using relatively short-lived radioisotope tracers in watercourses and water treatment plants and to facilitate experiments without using radioisotopes. For the special needs arisen in the course of the project prototype, instruments utilizing radioisotope tracer techniques have been constructed for the measurement of the velocity and direction of low velocity flow (0 to 15 cm/s) in watercourses and water treatment plants and for the measurement of the velocity and direction of ground water flow with borehole dilution techniques. Also a light-weight, battery operated counter utilizing a cassette recorder was designed and constructed for radioisotope tracer concentration measurements. (auth)

23301 (CONF-740701-, pp 459-466) LANTHANUM AS AN INTERNAL FLUX MONITOR IN RAIN SCAVENGING STUDIES INVOLVING INDIUM TRACER. Bhatki, K. S.; Dingle, A. N. (Univ. of Michigan, Ann Arbor). Jul 1974.

From 2nd international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

In order to study the basic mechanisms of circulation in severe connective storms, it was decided to release indium-115 in the clouds for tagging the rain to be collected at the ground downstream following such a storm. For estimating very small amounts, of the order of a few picograms per ml of water, of indium in the collected rain samples by a most sensitive method such as neutron activation, it became necessary to have precise knowledge of the neutron flux in the reactor. This difficulty was circumvented by employing lanthanum as an internal flux monitor and iron as a scavenger for both indium and lanthanum in these rain samples. (auth)

23302 (CONF-741040-P2, pp 174-181) MEASUREMENT OF THE THERMAL NEUTRON ABSORPTION CROSS SECTION OF ROCK SAMPLES BY A PULSED SOURCE METHOD. Allen, L. S.; Mills, W. R. Jr. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

Small portable accelerators have been used in oil well logging for the past decade. The uses of these accelerators for neutron logging have been supported by a continuing program of theoretical studies as well as experimental model measurements. For quantitative interpretation of field logs a measurement of the macroscopic thermal neutron absorption cross section, SIGMA/sub a/, of common rock materials is required. A pulsed neutron source technique for making such measurements in the laboratory is described. The method requires only one thermal neutron lifetime determination for a mixture of crushed rock saturated with pure water. The error in determining SIGMA/sub rock/ is less than or equal to 1 c.u. (capture unit equals 10^{-3} cm^{-1}). However, to reduce the effect of thermal neutron diffusion relative to absorption it is necessary to use crushed rock samples weighing approximately 15 to 20 kg. Although this limitation precludes application of the technique to small core samples, the method can be used to determine SIGMA/sub rock/ for any laboratory model whose material of construction is available. Results are given for both igneous and sedimentary rocks which outcrop in various parts of the United States. Most of the measured cross sections exceed the cross sections one would calculate for a given rock on the basis of its primary minerals. It is concluded that most of the rocks probably contain strongly absorbing trace elements such as boron or gadolinium.

23303 TELEDETECTION STUDY AND ISOTOPIC MEASUREMENTS OF HYDROLOGICAL RELATIONS BETWEEN SEA AND CONTINENT FOR DIFFERENT TYPES OF SHORE. Leveque, P. C.; Bellard, C.; Gros, J. C.; Maurin, C.; Severac, J. (Bordeaux-1 Univ., 33 (France)). pp 1-20, pt.B × Ca 121 of 2nd International Colloquium on the Exploitation of Oceans. Vol. 5. Oceanic Development Policies. Confrontation Sessions. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]). (In French)

From 2nd international colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

An attempt was made to determine the chief variations, behavior and development of fresh water masses in the zone of contact with seawater. The methods used involved chemical and isotopic (Cl, Na, K, Br, T, ^{14}C, ^{18}O) analyses and teledetection: colored aerial photographs, infrared emission from land and water, natural radioactivity measurements. The results were classified in morphological and structural types of shore: sandy coastline and homogeneous apparent permeability and karstic coasts. (FR)

Site Surveys

23304 (CEA-CONF-3124) NUCLEAR SITE SELECTION AND ENVIRONMENTAL PROTECTION: THE DECISION MAKING METHODS. Bresson, G.; Lacourly, G.; Fitoussi, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 6p. (CONF-750518-9). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

The siting of nuclear power plants is chiefly dependent on political, economical, social, and technical considerations. In every case these considerations take into account the problems raised by environmental protection that have lately reached an increasing importance owing to the fast development of the numbers of plants. Though they are many, the problems of environmental protection raised by the operation of nuclear plants can be reduced to the two following points: radioactive effluent releases and thermal discharges. From the point of view of methodology, there is some analogy between both problems and thus only radioactive releases are considered. The selection of the site of a nuclear plant most often involves a compromise between the operator of the plant who will try and reduce the cost price of his product to the lowest possible level and that of the protectionist who will try and reduce to the minimum the hazards to human populations resulting from the plant operation. Such a compromise is the result of a more or less empirical choice, which enters into the frame of a cost-benefit analysis, in which theoretically, the choice is between several possible solutions giving the higher advantage. Practically, however, the difficulties encountered in the cost evaluation process often make the choice highly subjective. As a matter of fact, the main difficulties to be met in the assessment of the consequences of radioactive releases into the environment are to be found in the monetary expression of the detriment. These difficulties result both from uncertainty on the dose-effect relationships and from the need to give human life a monetary value. (CH)

23305 (CEA-CONF-3125) FOOD CONTAMINATION AND THE GENERAL INVESTIGATION OF THE ENVIRONMENT OF NUCLEAR SITES. Bresson, G.; Lacourly, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 3p. (CONF-750518-10). Dep. NTIS $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

The selection of the siting of nuclear installations is chiefly governed by the general land use policy itself depending on political, geographical, economic, social, and technical factors. Until lately, there were few nuclear plants scattered over the country and the problems raised by environmental protection were thus easily solved. The population exposure resulting from the operation of these plants has always remained quite below the regulatory limits and the incidence of protection provisions is relatively slow as compared with the total cost of the installation. Now, the increased number of installations in the same region has led to consider the so-called limiting radiological capacity (LRC) i.e., the value of the annual releases resulting in a dose commitment for the critical group, equal to the dose limit recommended. The whole of the releases from the planned or operating installations should not exceed the LRC. This limitation is supplemented by the recommendation that doses be kept as low as readily achievable, economic and social considerations being taken into account. To that purpose, a cost-effectiveness analysis should be carried out for each installation resulting in an optimization of protection. The optimized dose is then the collective dose evaluated for a given installation or a group of installations corresponding to the lowest level of detriment, the cost of protection being taken into account. (auth)

23306 (NTIS/PS-75/748) POWER PLANT SITING. A Bibliography with Abstracts. Search Period Covered: 1964-September 1975. Hundemann, A. S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1975. 145p. NTIS $25.00.

Abstracts pertaining to the siting of nuclear power plants, solar thermal power plants, ocean thermal gradient power plants, and coal fired utilities are presented. Emphasis is on nuclear power plant siting and includes siting of underground nuclear facilities. Areas covered include geology, seismology, safety, social effects, economics, and environmental impacts. Abstracts dealing with the siting of power plants in countries other than the U. S. are included. 96 abstracts. (NTIS)

23307 MINERAL AND WATER RESOURCES OF NEVADA. Reno, NV; Nevada Bureau of Mines and Geology (1974). 314p. (NBMG-Bull.-65). $13.00.

The mineral and water resources of Nevada are summarily described in this report. Following a general description of the mineral industry and of the geology of the State as a whole, the occurrence, distribution, and relative importance of individual commodities are discussed in some detail. All mineral commodities are described that are known to occur in Nevada and that might have economic significance in the foreseeable future, whether or not they have been mined. In the description of the geology of the State, a section on economic geology describes the distribution of the metallic and nonmetallic mineral deposits both areally and with respect to the general geologic features. A knowledge of the pattern of distribution of known mineral deposits of

various types is essential to the successful search for new ore bodies. A section on mineral exploration discusses the methods and problems of exploration, and also considers which commodities in Nevada offer the greatest promise of new discoveries in the future. Water resources are described rather fully in this report; water in this generally arid part of the Great Basin is vital to the economy of the State and to the well-being of its people. Sources of waterpower and geothermal power are also discussed. (auth)

Thermal Effluents

Refer also to abstracts 23264, 23265, 23295, and 23341.

23308 (ANL-75-3(Pt.3), pp 133-142) COMPARISON OF THE MOVEMENT AND RECAPTURE OF SALMONID FISHES TAGGED AT TWO POWER PLANTS. Romberg, G. P.; Thommes, M. M. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Fish tagging studies were conducted in the vicinity of Point Beach Nuclear Plant and Waukegan Power Plant to determine whether there were any seasonal or site specific differences in the residence behavior of salmonids at thermal discharges. Results showed that there were differences in the abundance and time of peak abundance of trout and salmon at the two power plant discharges. Certain species reacted differently to the two discharges probably as a result of maturity and water temperature. Salmonids did not appear to remain at either discharge for long periods. Direction of migration was affected by stocking location and water temperature. (HLW)

23309 (ANL-75-3(Pt.3), pp 143-149) ORIGIN OF FIN-CLIPPED SALMONIDS COLLECTED AT TWO THERMAL DISCHARGES ON LAKE MICHIGAN. Romberg, G. P.; Thommes, M. M.; Spigarelli, S. A. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Fin clips observed on fish collected during tagging studies at the Point Beach and Waukegan thermal discharges were recorded and the data were tabulated by species. Using fin clip and fish size, attempts were made to identify probable stocking locations and dates from agency records. Data are presented for lake trout, rainbow trout, brown trout, and Coho salmon. Tables are presented to show probable stocking locations and dates. (HLW)

23310 (ANL-75-3(Pt.3), pp 150-154) EFFECTS OF SEASON, LOCATION, AND DISCHARGE TYPE ON FISH DISTRIBUTION AND DENSITY IN THERMAL PLUMES. Prepejchal, W.; Romberg, G. P.; Spigarelli, S. A. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Five replicate mapping studies were conducted at the Point Beach Nuclear Plant and the Waukegan Power Plant between April and September. Mapping runs were made in the plume areas to compare fish density and distribution in heated vs. unheated regions. Although there were no striking trends in fish distribution relative to bottom depth and depth stratum, there were differences between dates and locations, reflecting differential responses with time, species, and discharge type. Temperature orientation by fish was significantly different between plume and reference areas. Reference area fish were often most concentrated in the warmest ambient water, while plume fish were most concentrated at intermediate plume temperatures. (HLW)

23311 (ANL-75-3(Pt.3), pp 155-160) CHARACTERISTICS OF TEMPERATURE-SENSITIVE FISH TAGS USED IN 1974. Romberg, G. P.; Prepejchal, W. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

High variability of the TLD rods masked any small reductions in variability due to improved methods. Because temperature and exposure time are determined by the total change in signal (fade), the 4.6 percent standard error of a packet measurement is often a larger percentage of the absolute difference and consequently increases the minimum detectable differences. Since change in fade rate increases with increasing temperature, some advantage is gained when determining maximum discharge residence time; however, integrated fade in a fluctuating temperature environment is not directly related to true average temperature. By knowing these limitations, the integrated average temperature value, although higher than true average temperature, can still provide useful information about thermal exposure to fish. (auth)

23312 (ANL-75-3(Pt.3), pp 161-163) DISCHARGE RESIDENCE OF TLD TAGGED FISH. Romberg, G. P.; Prepejchal, W. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Although visual observations suggested that fish remained in the discharge for considerable periods, temperature-sensitive tags indicated the majority of fish spend less than 50 hr or 10 percent of the time at discharge temperatures. During 1974 a second fish tagging study was conducted, using temperature-sensitive tags to yield discharge residence times of Lake Michigan salmonids at Point Beach thermal discharge. Preliminary results revealed that many fish tag values were close to Unit I line indicating that calculated maximum discharge residence times for these fish will be nearly 100 percent of the elapsed time. (HLW)

23313 (ANL-75-3(Pt.3), pp 164-168) BODY TEMPERATURE CHANGE CHARACTERISTICS OF LAKE MICHIGAN FISHES. Spigarelli, S. A.; Thommes, M. M.; Beitinger, T. L. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Body temperature change rate experiments were conducted on alewife, brown trout, rainbow trout, brook trout, and carp collected from the discharge flumes and inshore areas near the Point Beach Nuclear Plant. Test fish were exposed to immediate water temperature changes of up to 10.6°C by transfer between ambient and discharge water holding tanks. Results showed that the temperature change rate was related to fish size, species, and direction of change, suggesting that rapid temperature changes would have a more pronounced effect on smaller fish. (HLW)

23314 (ANL-75-3(Pt.3), pp 169-172) BODY TEMPERATURES OF FISH FEEDING IN THE POINT BEACH THERMAL DISCHARGE. Spigarelli, S. A.; Thommes, M. M. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Between April and November, 1973, measurements of internal body temperature were made on 1310 fish caught by fishermen at the Point Beach Nuclear Plant. Records were also made of fish weight, length, and sex and intake and discharge temperatures. A table is presented to show mean monthly body temperatures and numbers of each species. Approximately 76 percent of the measurements were made on rainbow and brown trout, since these species accounted for 74 percent of the catch. Body temperatures of most fish were intermediate between intake and discharge temperatures. Results suggested that each species has rather specific seasonal temperature requirements and that the maximum discharge temperature was normally avoided by feeding fish. (HLW)

23315 (ANL-75-3(Pt.3), pp 173-179) GROWTH OF PLUME "RESIDENT" FISHES IN LAKE MICHIGAN. Spigarelli, S. A.; Smith, D. W. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Brown trout, rainbow trout, and chinook salmon were collected from the Point Beach thermal discharge area, tagged with commercial dart tags and temperature-sensitive tags, and released back into the discharge area. RNA and DNA analyses were performed on epaxial muscle samples taken from each tagged fish recaptured in the plume area and from control fish. A table is presented to show mean weights, condition factors, and RNA-DNA ratios for each group of fish. Results indicated that the fish did not experience any severe growth abnormalities as a result of their residence in the thermal plume area. (HLW)

23316 (ANL-75-3(Pt.3), pp 180-183) EFFECT OF PLUME RESIDENCE ON THE ACCUMULATION OF ^{137}Cs BY LAKE MICHIGAN SALMONIDS. Spigarelli, S. A.; Edwards, J. 1974.

In Radiological and Environmental Research Division annual report, January–December 1974. Ecology. (Argonne National Lab., Ill. (USA)).

Brown trout, rainbow trout, and chinook salmon were tagged with temperature-sensitive tags and released back into the Point Beach discharge area. Gamma spectral analysis detected only ^{137}Cs and ^{40}K in the fish samples. A comparison of mean ^{137}Cs concentrations in all groups for 1971 and 1973 showed that 1971 levels were significantly higher than 1973 levels. (HLW)

23317 (CONF-750980-2) IMPACT OF POWER PLANTS ON AQUATIC SYSTEMS: A SOCIAL PERSPECTIVE. Coutant, C. C. (Oak Ridge National Lab., Tenn. (USA)). 1975. 8p. Dep. NTIS $3.50.

From Workshop on impact of power plants on aquatic systems; Pacific Grove, California, USA (28 Sep 1975).

Topics discussed are: aquatic effects of thermal electric power stations; legal aspects of water pollution; EPA provisions for levels of thermal discharges to assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in a body of water; cost benefit analysis of steam electric power effluents; cooling systems and siting of power plants; simulation modeling of population dynamics; and sociological aspects of water pollution. (HLW)

23318 (PB-240756) ENVIRONMENTAL RESPONSES TO THERMAL DISCHARGES FROM THE INDIAN RIVER STATION, INDIAN RIVER, DELAWARE. Report No. 12, 1967–74. Jensen, L. D. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). Nov 1974. 220p. NTIS $7.25.

See also report dated Mar 1974, PB-240755, and report dated Nov 1974, PB-240757.

Interest on the part of the Delmarva Power and Light Company led to the collection of data from the Indian River Power Station. The studies have involved a detailed examination of water quality and nutrients in addition to temperature in the Indian River estuary. Fisheries data were collected in the Indian River to study the normal distribution of adult and juvenile fishes of both resident and migratory species. Studies on the species composition of the benthic invertebrates have also been conducted. Planktonic investigations have involved population studies in the estuary and have been augmented by entrainment studies of passing microscopic organisms through the condenser system of the power station. An estuary, such as the Indian River, is an extremely complex and productive ecosystem supporting a rich assembly of organisms. The estuary provides an essential habitat for spawning and nurturing the young of many coastal fishes of both commercial and recreational importance. (GRA)

23319 (TID-26952) THERMAL STRESS IN THALASSIA TESTUDINUM. Schroeder, P. B. (Miami Univ., Coral Gables, Fla. (USA)). 6 Oct 1975. 169p. Dep. NTIS $6.75.

Thesis.

A study of the effect of a thermal effluent on Thalassia testudinum was made at Guayanilla Bay, Puerto Rico, and at the laboratory of the Puerto Rico Nuclear Center at Mayaguez, Puerto Rico. Biomass of Thalassia was inversely correlated with temperature in established turtle grass flats near a thermal plume. Visual signs of stress were noted in transplanted Thalassia samples after two weeks of exposure to temperatures of 34.5^0 to 35^{0}C. Mortality occurred in transplanted Thalassia after seven weeks of exposure to 35.0^0 to 36.4^{0}C. Biomass and pigment values varied nonlinearly with temperature. There was strong correlation between the effect of temperature on biomass and on the absorption ratio 410 nm/665 nm of acetone extracts of leaf material between 28^0 and 36^{0}C. This absorption ratio was proposed as an index of thermal stress in the plant. Radionuclide uptake experiments demonstrated that osmoregulation in Thalassia was affected by temperature. Sodium and certain other cations were preferentially excluded from Thalassia at temperatures normally experienced by the plant. Between 32^0 and 34.5^{0}C accelerated uptake of these cations in leaves occurred. Sodium poisoning and breakdown of osmoregulatory processes were proposed as the cause of visual signs of thermal stress and mortality in Thalassia. (auth)

23320 EFFECTS OF TEMPERATURE UPON THE TOXICITY OF CHEMICALS TO AQUATIC ORGANISMS. Cairns, J. Jr.; Heath, A. G.; Parker, B. C. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Hydrobiologia; 47: No. 1, 135–171(1975).

Although rather extensive bibliographies give the impression that there is a vast amount of literature on the effects of temperature on aquatic organisms, when one tries to apply this information to specific interactions, such as the effects of temperature changes on chemical toxicity to aquatic organisms, often very little of the evidence is applicable. Although the most useful information on this relationship has been acquired in laboratory situations even this body of literature (which forms the bulk of this paper) is not adequate to make any scientifically justifiable generalizations. Field data on this relationship is almost nonexistent and it is unlikely that much will become available unless specific studies are initiated which are directed toward this end. This is equally true of the laboratory information although it seems more likely that this will be generated as a spinoff from other research activities. In order to develop water quality management programs for steam-electric power plants one should understand the relationship between temperature and the response of aquatic organisms to toxic chemicals. Not only do some power plants discharge chlorine and other similar materials as well as heated waste water but those that discharge the latter only may be located near discharges of toxic chemicals. Since temperature and chemical stress to aquatic organisms are most commonly discussed independently it was felt that a paper covering this relationship would be useful. (auth)

Chemical Effluents

Refer also to abstracts 23293, 23294, and 23336.

23321 (CEA-CONF-3123) CONSEQUENCES OF THE RELEASE OF CHEMICAL POLLUTANTS ON THE TRANSFERS OF RADIOACTIVE PRODUCTS IN AQUATIC SYSTEMS. Bittel, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 3p. (CONF-750518–4). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

With the increasing rate of industrial activities, aquatic systems undergo, more and more frequently, the accumulation of chemical and radioactive wastes released separately or associated in the same discharge. An attempt is made to evaluate the consequence of the association of pollutants. Emphasis is given to heavy metal pollution and complexing agents. (auth)

23322 (CONF-740701-, pp 10-23) ROLE OF NEUTRON ACTIVATION ANALYSIS IN THE STUDY OF HEAVY METAL POLLUTION OF A LAKE-RIVER SYSTEM. Filby, R. H.; Shah, K. R.; Funk, W. H. (Washington State Univ., Pullman). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Details of a study of combined organic and metallic pollution of the Coeur d'Alene Lake-River and Spokane River system and the role played by nuclear techniques in the investigation are presented. The Coeur d'Alene River drains through the N. Idaho Pb–Zn mining region of Kellogg and the mining industry is the major source of metallic pollution of the lake and river system. The first part of the study has involved the determination of Pb, Zn, Ag, Cd, As, Cu, Sb, Co, Cr, Cs, Rb, Sc, Ba, Eu, La, Tb, Y, Zr, Fe, Mn, Mo, by INAA in waters, sediments and organisms throughout the region. Extremely high values for Pb, Zn, Sb, Fe and other metals were found in the Coeur d'Alene River delta sediments and in the lake sediments. A procedure involving immediate filtration of a 100 ml aliquot through a 0.4 mu Nucleopore filter followed by rapid freezing of samples in high purity polyethylene bags has been adopted. After return to the laboratory, water samples are freeze-dried and the bag plus sample is analyzed by INAA. Inhomogeneous distribution caused by adsorption on surfaces or by precipitation/adsorption during irradiation of liquid samples is avoided. Radioisotope studies of volatile elements such as Br, Hg, Se, As, and Sb have shown no losses from water samples during freeze drying. A particularly useful application of INAA is the determination of metal forms in river waters. In this study the metal content of normal and polluted waters was fractionated into particulate, cationic, anionic and neutral fractions by filtration/ion-exchange. High purity ion-exchange resins were used allowing a large volume of water to be sampled and the ion exchange resins were analyzed directly by INAA. For kinetic studies of the uptake of metals on clay minerals, AAS has been found to be the best technique. In a study of Zn uptake by illite, montmorillonite and kaolinite, AAS was used allowing the study of rapid adsorption processes. Results from the study of metals in an aquatic ecosystem show the value of combining nuclear techniques with other methods of trace analysis in practical pollution problems.

23323 (CONF-740701-, pp 24-31) NEUTRON ACTIVATION ANALYSIS STUDIES OF MARINE BIOLOGICAL SPECIES AND RELATED MARINE SEDIMENTS. Guinn, V. P.; Di Casa, M.; de Goeij, J. J. M.; Young, D. R. (Univ. of California, Irvine). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

To assess the effects, if any, of elemental pollution of the Pacific Ocean from the major Southern California sewage outfalls, samples of ocean sediments were obtained and specimens of Dover Sole were caught in a number of locations. Liver tissue

samples from Dover Sole specimens were analyzed for 12 elements and sediment samples for 4 elements. Although a number of the elements were highly concentrated in the surface sediments in the heavily-polluted areas, the Dover Sole showed no evidence of picking up any of the 12 elements from these polluted sediments. Sediment profiles, versus depth, (0-34 cm) were also determined for As, Sb, Se, and Hg. Stemming partly from the results of the NSF Baseline Study, the Southern California Coastal Water Research Project (SCCWRP) became interested in a more intensive multi-element study of marine biological species and ocean sediments off the coast of Southern California. The purpose of this study was to assess the effects, if any, of a number of selected elements of interest being discharged into the Pacific Ocean from the principal sewage outfalls in the Southern California (Los Angeles) area upon marine biological species. The 12 elements selected for study were Cr, Fe, Co, Cu, Zn, As, Se, Mo, Ag, Cd, Sb, and Hg. Since a number of these elements were not amenable to purely instrumental NAA measurements, a suitable post-irradiation radiochemical separation procedure was devised, thoroughly tested, and then applied to 39 samples of liver tissue from specimens of Dover Sole caught in non-polluted, slightly-polluted, fairly-polluted, and heavily-polluted areas along the coast. A number of surface sediment samples from these same locations were also analyzed, by both instrumental and radiochemical NAA. In the following sections, the samples analyzed are cited, the procedures developed and employed are described, the results obtained are presented, and the conclusions reached are discussed.

23324 (CONF-740701-, pp 106-122) CYCLIC ACTIVATION IN TRACE ELEMENT ANALYSIS OF ENVIRONMENTAL SAMPLES. Spyrou, N. M.; Ingle, K.; Ozek, F. (Univ. of Surry, Guildford, Eng.). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Certain toxic and essential trace elements in biomedical and environmental studies are not readily measured using instrumental neutron activation analysis. A non-destructive technique is proposed here, termed cyclic activation, which makes possible the detection of elements which produce short-lived isotopes on irradiation in a reactor. A brief mathematical description is given interrelating the various timing parameters involved and graphical interpretation of these quantities is presented. The technique is illustrated by application to the detection of lead via the /sup 207 m/Pb isotope (0.8s half-life) in various matrices and suggestions for improvement are made to increase its accuracy.

23325 (CONF-740701-, pp 123-129) MULTIELEMENT DETERMINATION IN ENVIRONMENTAL NAA USING MONSTR. Emery, J. F.; Dyer, F. F. (Oak Ridge National Lab., TN). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

MONSTR is a computer program for the resolution and isotopic identification of Ge(Li) gamma-ray spectra. There are over 20 commands for energy and detector efficiency calibration, spectral resolution data analysis and input/output. The photo peaks are automatically located and fitted by least squares to a gaussian function that is capable of resolving multiplets containing up to four photo peaks. A maximum of 71 photo peaks are stored for isotope identification. Spectra are automatically corrected for the main amplifier dead time, and decay during the count interval for short half life nuclides. The table used in isotope identification contains over 1200 gamma-rays and 320 nuclides. These tables can be expanded to over 1000 nuclides. MONSTR, written in FORTRAN IV runs on a 8192 word PDP15/20 computer interfaced to a 4096 word multichannel analyzer.

23326 (CONF-740701-, pp 141-143) FISSION TRACK TECHNIQUE FOR URANIUM DETERMINATION IN COAL AND FLY ASH STANDARD REFERENCE MATERIALS. Carpenter, B. S.; Reimer, G. M. (National Bureau of Standards, Washington, DC). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

The analysis of coal and combustion waste products for uranium will become increasingly important with the greater use of coal for supplying energy needs. A fission track technique, as demonstrated with NBS Standard Reference Material Trace Elements in Coal (SRM 1632) and Trace Elements in Fly Ash (SRM 1633), provides a rapid and inexpensive method for U analysis. (auth)

23327 (CONF-740701-, pp 154-167) ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF 20 TRACE ELEMENTS IN BIOLOGICAL SAMPLES BY MEANS OF INSTRUMENTAL THERMAL NEUTRON ACTIVATION ANALYSIS. Kasperek, K. (Nuclear Research Center, Juelich, Ger.). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Analytical techniques for the determination of Al, Ag, Br, Cl, Co, Cr, Cs, Eu, Fe, Hg, K, Mn, Ni, Rb, Sb, Sc, Se, Ta, Zn, and W in biological samples with the aid of instrumental thermal neutron activation analysis are reported. In order to determine these elements two different types of irradiation are necessary, a short term and a long term irradiation. In case of short term irradiation for determination of Al, Br, Cl, K, Mn, Na, and W each sample is capsuled in polyethylene and irradiated with a high thermal neutron flux for a short time (for example 1 minute). Only a few minutes after irradiation, the gamma-spectra of the short-lived isotopes are measured using a multichannel impulse height analyzer combined with a 90 cm^3 well type Ge(Li)-detector. The data are entered into the store of a computer. For determination of the other elements, the samples can be irradiated for a maximum of 1 h in polyethylene in a cooled irradiation facility (temperature 4 to 20°C). For longer irradiation each sample is transferred to a silica container. After the decay of most of the Na-24 radioactivity has occurred, the samples are removed from the silica container and transferred into an unirradiated container for measuring of radioactivity. In these cases it is necessary to measure the neutron flux for each sample separately. For calculation of element concentrations an IBM computer 370/165 or a PDP 11/40 is used in connection with a special program and a library, consisting of gamma-spectra of the elements.

23328 (CONF-740701-, pp 187-197) ENVIRONMENT AS REFLECTED IN HUMAN TISSUE AND HAIR: A COMPARISON. Dale, I. M.; Lenihan, J. M. A.; Smith, H. (West of Scotland Health Boards, Glasgow). Jul 1974.

In second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

This study looks at variations in trace metal content of a range of human tissues over a period of 10 years, extended comparison of metal concentrations in hair specimens over 200 years, the influence of geographical location on trace element levels in hair and nails and investigates groups of people with particular exposure problems. It is found that there has been little or no change in the concentration of some of the trace elements in human tissue over the past ten years. An extended survey of hair over the past 200 years shows a similar result. Investigation of trace element levels from widely separated localities also indicates little or no change in metal concentrations. It appears from these studies that man's contamination from his environment has remained fairly constant with respect to time and place. However it is shown in further studies that local pockets of significant exposure, e.g., particular professions, industry, agriculture and self-medication, do occur and certainly warrant close attention.

23329 (CONF-740701-, pp 198-205) TRACE-ELEMENT CONTENT OF HUMAN SCALP HAIR. Gordus, A. A.; Wysocki, C. M.; Maher, C. C. III; Wieland, R. C. (Univ. of Michigan, Ann Arbor). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

The importance of some of the factors that could affect the measured trace-element content of human scalp hair have been evaluated. Included are frequency of hair washing and swimming, shampoos used, gross differences in diet, and the variation in content along the strands of hair. The data for length-content variation suggest that, for some elements, eccrine sweat may contribute significantly to the measured trace-element content of hair and that such variation must be taken into account in assessing data for historical hair samples, many of which represent clippings of distal segments of hair.

23330 (CONF-740701-, pp 206-212) DETERMINATION OF MOLYBDENUM AND SELENIUM IN BIOENVIRONMENTAL SAMPLES USING NEUTRON ACTIVATION ANALYSIS. Abu-Samra, A.;

Morris, J. S.; Koirtyohann, S. R.; Vogt, J. R. (Univ. of Missouri, Columbia). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Because of the increasing interest as to their roles in biological systems, a procedure has been developed by which molybdenum and selenium can be determined at nanogram levels in these types of samples. Results from the analysis of orchard leaves and bovine liver are presented. The samples are packaged in pre-cleaned quartz vials prepared from GE-204 tubing. If both selenium and molybdenum are to be determined, the samples are irradiated for 40 or more hours at a thermal neutron flux of 8×10^{13}n cm^{-2} sec^{-1}. After the samples have decayed for approximately 48 hours the vials are unpackaged, cleaned in aqua-regia, and broken. The irradiation period can be reduced to 24 hours if molybdenum is to be determined individually or if the selenium content is known to be 1 microgram or more. The sample is digested with carriers and the selenium is then distilled as a volatile selenium halide. Elemental selenium is precipitated by reduction with SO_2 produced through the protonation of the hydrogen sulfite ion and subsequent decomposition of the resulting sulfurous acid. The 401 keV summation peak of ^{75}Se is normally used for quantitative determination. The chemical yield is determined by drying and weighing the elemental selenium.

23331 (CONF-740701-, pp 213-223) ACCUMULATION OF MERCURY IN FISH. Kraemer, H. J.; Neidhart, B. (Technische Hochschule, Darmstadt, Ger.). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

In model experiments the direct uptake (excluding the food chain) of different dissolved mercury compounds by female species of Poecilia reticulata was investigated using the radiochemical tracer method. Hg-203 labelled $Hg(NO_3)_2$ and CH_3HgCl were dissolved in deionized water resulting in concentrations of 0,1/1/5/10 and 20 ng Hg/ml H_2O. The fish were measured in vivo using a 3" x 3" NaI(Tl) well-type-detector. The experiments showed, that the accumulation rate (ng Hg/g/sub fi/ . d) depends very much on the chemical form and the concentration of the dissolved Hg-compound. The accumulation in a CH_3HgCl-solution is about four times as fast as in a $Hg(NO_3)_2$ solution. In the presence of complexing agents the accumulation rates decrease whereas the accumulation rates increase with increasing Hg-concentration in the water. The release of incorporated methyl-mercury has a half life of about 69 days. For inorganic mercury a two step mechanism has been found with half lives of 4 days and 68 days, respectively. The relative amount of mercury released in the second step increases with increasing time of incorporation. This indicates the methylation of inorganic mercury in the fish.

23332 (CONF-740701-, pp 234-239) NEUTRON ACTIVATION ANALYSIS OF URINARY CALCULI. Souka, N.; Souka, S.; Sanad, W.; Abdel-Rassoul, A. A. (Atomic Energy Establishment, Cairo). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Urinary calculi resulting from disorders in the urinary system are mostly composed of uric acid, urates, calcium oxalate, alkaline earth phosphates (Ca and Mg), triple phosphate (magnesium ammonium phosphate), calcium carbonate, cystine, xanthine, and traces of proteins. The determination of these macro-constituents has been carried out by different analytical procedures. No attempts however, have been reported regarding the determination of trace elements in urinary stones, apart from that of Herring et al., who investigated the consumption of strontium by urolithiasis patients. The present work is a non-destructive neutron activation analysis of urinary calculi, to search the variation in concentration of certain trace elements with the chemical composition of the calculus.

23333 (CONF-740701-, pp 240-249) DEVELOPMENT OF METHODS FOR THE NEUTRON ACTIVATION ANALYSIS TO THE DETERMINATION OF ESSENTIAL AND TOXIC TRACE ELEMENTS OF BIOLOGICAL AND ENVIRONMENTAL SAMPLES: APPLICATION OF ENZYME ACTIVITY OF RAW HIDES. Sipos, T. (Artificial Leather and Footwear Industries, Budapest); Nagy, L. G.; Toeroek, G.; Kollar, J. Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Investigations on the post mortem enzymatic processes pointed out the fact, that significant deviations can be observed in the extent and in the results of the autolytic transformations occurring during the storage of raw hide. A neutron activation analysis procedure, based on a semiautomated radiochemical separation procedure and scintillation gamma spectrometry, was selected for the determination of some trace elements. Six trace elements, Cu, Mn, Zn, Au, As, and Cr, and one minor component, Br, were detected and/or determined in the concentration region of $0,1\text{-}10^3$ ppM. According to preliminary investigations evaluated at the time being, concentration differences of some orders of magnitude were obtained for some trace elements: copper, zinc and manganese, whereas the concentration of bromine remained practically constant. These findings seem to correlate with large differences in appearance due to different enzyme activities in the raw hides.

23334 (CONF-740701-, pp 286-300) ENVIRONMENTAL MONITORING NEAR URBAN LEAD REFINERIES BY PHOTON AND NEUTRON ACTIVATION ANALYSIS. Paciga, J. J.; Chattopadhyay, A.; Jervis, R. E. (Univ. of Toronto, Ont.). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

Photon activation has been used in conjunction with neutron activation for multielement determinations in airborne particulates, soil, and hair samples collected near two secondary lead refineries in Metropolitan Toronto. Particle size distributions of suspended particulates collected with a high volume Andersen sampler are reported for Al, Sb, As, Br, Cl, Mn, Na, Pb, Ti and V. Increases in the concentrations of Pb, As and Sb associated with particles greater than 3,3 mu m diameter on certain days near the refineries has resulted in localized contamination as reflected in higher concentrations of these elements in soil. To assess Pb accumulation in local residents compared with control groups, approximately 250 hair samples were analyzed for Pb by photon activation analysis. Children living close to the refineries, especially boys, exhibit the most elevated levels: up to 20 times urban control values in some cases.

23335 (DPSPU-75-30-11) COMPUTER HANDLING OF SAVANNAH RIVER PLANT ENVIRONMENTAL MONITORING DATA. Zeigler, C. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Dec 1975. Contract AT(07-2)-1. 11p. (CONF-760202-28). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

At the Savannah River Plant, computer programs are used to calculate, store, and retrieve radioactive and nonradioactive environmental monitoring data. Objectives are to provide daily, monthly, and annual summaries of all routine monitoring data; to calculate and tabulate releases according to radioisotopic species or nonradioactive pollutant, source point, and mode of entry to the environment (atmosphere, stream, or earthen seepage basins). The computer programs use a compatible numeric coding system for the data, and printouts are in the form required for internal and external reports. Data input and program maintenance are accomplished with punched cards, paper or magnetic tapes, and when applicable, with computer terminals. Additional aids for data evaluation provided by the programs are statistical counting errors, maximum and minimum values, standard deviations of averages, and other statistical analyses. (auth)

23336 (ERDA-54(Suppl.)(74)) ENVIRONMENTAL MONITORING AT MAJOR U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION SITES. Calendar Year 1974. Supplement. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Operational Safety). Jan 1976. 102p. Dep. NTIS $5.45.

Environmental Monitoring at Major U.S. Energy Research and Development Administration Contractor Sites ERDA-54 (74), a compilation of the annual environmental monitoring reports prepared and issued by ERDA sites for calendar year 1974, did not include reports by Battelle Columbus Laboratories and Idaho National Engineering Laboratories. These reports have been completed and are presented in this supplement to ERDA-54 (74). (auth)

23337 (LA-6216-PR) DEVELOPMENT OF AIR-MONITORING TECHNIQUES USING SOLID SORBENTS. LASL Project R-059,

NIOSH-IA-75-31. Progress Report, April 1, 1975–September 30, 1975. Wood, G. O.; Anderson, R. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1976. Contract W-7405-eng-36. 13p. Dep. NTIS $4.50.

Work toward the specification of methods for air sampling and analysis of four groups of organic compounds has continued. These four groups are (1) low-boiling aliphatic amines, (2) low-boiling hydrazines, (3) pyridines, and (4) formaldehyde. The methods involve collection of vapors on a solid sorbent in a tube through which air is drawn. Retention of n-butylamine, pyridine, and 1,1-dimethylhydrazine has been measured for several sorbents. The most effective is sulfuric acid-coated silica gel. A second step in each method is the removal of the sample from the selected sorbent by elution with a solvent. Desorptions of seven aliphatic amines from silica gel, of pyridine from porous polymers and sulfuric acid-coated silica gel, and of formaldehyde from alumina have been studied. A gas chromatographic method was developed for pyridine and 2-amino-pyridine analysis. Storage of formaldehyde collected on alumina was measured. The rapid loss observed limits the sampling period to 30 min and requires immediate elution. Alumina tubes and bubblers were compared for sampling formaldehyde vapors in air. (auth)

23338 (LA-UR-76-123) CURRENT TECHNOLOGY IN SAMPLING FOR AIRBORNE RADIONUCLIDES. Schulte, H. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1976. Contract W-7405-eng-36. 12p. (CONF-751174-1). Dep. NTIS $3.50.

From proceedings on radionuclides in the environment; Palo Alto, California, United States of America (USA) (22 Nov 1975).

Sampling for airborne radionuclides is an important part of assessing the occupational environment and that of the public or out-plant environment. Both of these are important to the operation of any nuclear facility. Most such facilities do not emit radionuclides continuously to any extent and hence both the occupational and environmental sampling system is designed to detect deviations from normal conditions or untoward events. Work with materials of a low degree of radioactivity or with nonradioactive materials may involve operations which are not enclosed and significant contaminating material may always exist in the air. In this case, the sampling is directed toward measuring this ambient level and assessing its continued impact on the worker and on the environment. Publication No. 12 of the International Commission on Radiological Protection specifies the types of operations where sampling is necessary for worker protection and the American National Standards Institute publication N 13.1-1969 is a guide to the methods used. Increasingly, this field is covered by various regulations which specify when sampling must be done and, in some cases, how it shall be done. These include requirements of the Occupational Safety and Health Administration, the Nuclear Regulatory Commission, and the Environmental Protection Agency. Needless to say, where these have specified methods they must be followed although in most cases exact procedures are not detailed as requirements. Within the plant, needs for sampling are often suggested by surface monitoring results and by bioassay, and outside by analysis of plants, soils, and material from fallout trays. 15 references. (auth)

23339 (PB-241336) EFFECTS OF CERTAIN CHEMICAL POLLUTANTS ON SMALL AQUATIC ANIMALS. Project Completion Report, May 1973–June 1974. Bovee, E. C. (Kansas Water Resources Research Inst., Manhattan (USA)). Jan 1975. Contract DI-14-31-0001-3816. 17p. NTIS $3.25.

A quick, accurate, photomicrographic method has been developed for bioassaying the presence and concentration of heavy-metals pollutants in water. The method detects toxic levels of pollutants and for a single toxic metal will detect one part of metal in one billion parts of water. The animal used, the ciliated protozoan, Tetrahymena pyriformis, is easily and cheaply raised in the laboratory and is poisoned by the same levels of metals as the blue-gill sunfish. The bioassay is run in less than half a day, including developing and analysis of films of the locomoting animal on which the assay depends. With reference-graphs of the pollutants, the method is potentially of practical use to laboratories interested in detecting presence and amounts of pollutants in a water source or plant-effluent. In "hard" waters calcium, especially, and non-toxic cations, e.g., sodium, potassium, magnesium, partly inhibit toxic effects of heavy metals. (GRA)

23340 (UCRL-52001) FEASIBILITY STUDY FOR AUTOMATION OF THE CENTRAL LABORATORIES, WATER RESOURCES DIVISION, U. S. GEOLOGICAL SURVEY. Morris, W. F.; Peck, E. S.; Fisher, E. R.; Barton, G. W. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jan 1976. Contract W-7405-eng-48. 53p. Dep. NTIS $5.45.

This study of the feasibility of further automating the Central Laboratories deals specifically with the combined laboratory operations in Salt Lake City, Utah, and Denver, Colorado and is prepared with the understanding that such a system will also be implemented at the Central Laboratories in Atlanta, Georgia, and Albany, New York. The goals of automation are defined in terms of the mission of a water analysis laboratory, propose alternative computer systems for meeting such goals, and evaluate these alternatives in terms of cost effectiveness and other specified criteria. It is found that further automation will be beneficial and an in-house system that incorporates dual minicomputers is recommended: one for time-shared data acquisition, processing, and control; the second for data management. High-use analytical instruments are placed on-line to the time-shared minicomputer, with a terminal at each instrument and backup data storage on magnetic tape. A third, standby computer is switched in manually should the time-shared computer go down. Field-proven, modular hardware and software are chosen. Also recommended is the incorporation of the highly developed, computer-integrated instruments that are commercially available for determining petrochemicals and other organic substances, and are essential to the Laboratories' mission. (auth)

23341 ACTION OF THE MINISTRY OF ENVIRONMENT WITH REGARD TO PROTECTION OF THE MARINE ENVIRONMENT. Lys, M. (Ministere de la Qualite de la Vie, 75–Paris (France)). pp 1-13, pt.B × Ca308 of 2nd International Colloquium on the Exploitation of Oceans. Vol. 5. Oceanic Development Policies. Confrontation Sessions. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]). (In French)

From 2nd international colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

The activity of the Ministry of Environment is reviewed in the following contexts: general cleaning up of the coastline; installation of nuclear power plants; open-sea burning of chlorinated industrial wastes; and fight against pollution caused by ships at sea. (FR)

INSTRUMENTATION

Radiation Detection Instruments

23342 (NCSR-R-3) RELIABILITY DATA ON ELECTRONIC COMPONENTS FROM THE HARWELL SERIES OF NUCLEONIC EQUIPMENTS. Moss, T. R.; Youdell, L. W. (National Centre of Systems Reliability, Culcheth (UK)). 1975. 85p. Dep. NTIS (US Sales Only) $5.00.

Details of failures and modifications to the Harwell series of nucleonic equipments for the period January 1969 to December 1971 have been analyzed. The data flow diagrams and the processed data are presented. Since the populations were large, the data can be employed for reliability studies with a high degree of confidence.

General Detectors and Monitors

Refer also to abstracts 23300, 23478, 23485, 23853, 23925, 23931, 23933, 23934, 23944, 23945, 23956–23967, 23984–23987, 23989, 24187, 24188, and 25282.

23343 (BNWL-SA-5605) TECHNOLOGICAL CONSIDERATIONS IN EMERGENCY INSTRUMENT PREPAREDNESS. Selby, J. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 8p. (CONF-751116-29). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

The types of emergency instrumentation systems necessary to characterize the severity and extent of radiation accidents and to aid in the protection of operating personnel and personnel living near the plant are discussed. These include instruments for direct measurement of the airborne radioactive material within the facility, fixed instrumentation for ambient dose rate monitoring or area monitoring, and portable instruments for environmental monitoring. (WHK)

23344 (CRN-HE-75/8) AUTOMATIC MONITORING OF THE GAIN OF PHOTOMULTIPLIERS IN A PARTICLE BEAM. Callot, O.; Meyer, J. M. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires). May 1975. 15p. (In French). Dep. NTIS (US Sales Only) $3.50.

An automatic gain survey has been performed on 32 scintillation counters used to measure particles energy loss. Depending on the beam intensity, sizable variations in the photomultiplier gain have been measured. The control system allowed to study these variations as a function of time. (auth)

23345 (ESRO-SP-106, pp 323-337) PHYSICAL CHARACTERISTICS OF THE COS-B γ-RAY EXPERIMENT. Bennett, K.; Burer, J. J.; Gorisse, M. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The overall response of the COS-B gamma-ray detector to photons and to charged particles has been determined empirically by exposing the Engineering Model to beams at particle accelerators. Tagged photon beams with energies between 20 MeV and 6 GeV were provided at DESY, Hamburg. The effect of the charged particle environment in orbit was investigated by means of proton beams at CERN and electron beams at DESY. These beam tests have been analysed to determine the following physical properties of the COS-B payload: The susceptibility to charged-particle induced background. The effective sensitive area for point sources as a function of the incident photon energy and the source direction with respect to the optical axis. The geometric factors for a line source and isotropic radiation. The angular resolutions. The energy resolutions. The measurements and analysis procedures are described and the results are presented.

23346 (ESRO-SP-106, pp 363-368) OBSERVATION OF TERRESTRIAL ALBEDO γ-RAYS FROM THE COS-B ORBIT. Wills, R. D. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

It has been suggested that a cross check of the sensitivities of different satellite-borne γ-ray detectors might be achieved by using the Earth's atmosphere as a calibration source. Stecker has computed an intensity of γ-rays about 100 MeV at an altitude of 500 km which is consistent with the observed counting rate of OSO-3. If these results can be extrapolated to greater distances and lower energies, they may be folded with the response of the COS-B experiment (as measured at accelerators) to give an estimate of the counting rate to be expected as a function of distance from the Earth and the angle between the experiment axis and the Earth-satellite vector. The results of such extrapolations are discussed in terms of their implications for a possible orbital calibration of COS-B and for the observation of sources in directions close to the Earth. (auth)

23347 (HMI-B–184) CONTRIBUTION TO TIME-INTERVAL DIGITIZING OF HIGH RESOLUTION BY THE VERNIER PRINCIPLE. Conrad, R. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Datenverarbeitung und Elektronik). Oct 1975. 120p. (In German). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Technische Univ., Berlin.

This work gives a contribution to the time-interval digitizing of high resolution by the Vernier principle as it is often used in nuclear experiments. After clearing the quality criterions of such digitizers and a comparison of the known main principles new solutions are shown for the critical points of the Vernier principle. The main view is directed to the stability of the started oscillators, the measuring of the actual vernier scale and the control of the oscillators after each measuring period, the possibility of correcting the result by using the actual vernier scale and a principle to fit exactly the mainscale to the vernier scale. At the end critical remarks concerning the input circuitry and accuracy are given. At the Hahn-Meitner-Institut fur Kernforschung Berlin GmbH a prototype was implemented with a resolution of less than 45 ps, a width of a word of 20 bit = 10^6 channels and a differential nonlinearity of less than 0.5%.

23348 (LBL-4632) HIGH EFFICIENCY COLLIMATOR-CONVERTERS FOR NEUTRAL PARTICLE IMAGING WITH MWPC. Chu, D.; Tam, K. C.; Perez-Mendez, V.; Lim, C. B.; Lambert, D.; Kaplan, S. N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 9p. (CONF-751116-22). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A MWPC with external collimator converter system has been developed specifically for the detection of 0.511 MeV gammas in a positron camera. The design basis is applicable also to the imaging of other gammas and neutrons. The converter consists of honeycomb cells which provide an enhanced area of escape surface as well as restricting the range of conversion electrons to the cell dimensions. (WHK)

23349 A NEUTRON PROPORTIONAL COUNTER WITH A LOOPED ANODE. Lecuyer, P. L. D. (to Le Materiel Telephonique (LMT), 75–Paris (France)). French Patent 2,234,656/A/. 22 Jun 1973. 7p. (In French)

The cathode-anode combination of a proportional counter of the charge-multiplication type contains an anode wire in the shape of a loop which is electrically open and freely moveable within the enclosure constituted by the cathode. The loop can also be partially imbedded in the insulating holder-block. This can be applied to neutron counters in a gaseous atmosphere. (FR)

23350 EXPERIMENTAL GEOMETRICAL ATTENUATION FACTORS FOR A 35 cc Ge(Li) DETECTOR. Bhuloka Reddy, S.; Sudhakar, K.; Premchand, K.; Narasimham, K. L.; Thirumala Rao, B. V.; Lakshminarayana, V. (Andhra, Univ., Waltair, India). pp 288-289 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

In directional correlation studies using large volume Ge(Li) detectors, for an accurate determination of the correlation coefficients, corrections have to be applied to the experimentally determined values for the finite size of the detector. In the case of lithium drifted germanium detectors, this correction is best applied by experimentally determining the geometrical attenuation factors. The collimated beam technique is employed for the experimental determination of these factors with increasing beam size and source-to-detector distance for a 35 cc coaxial Ge(Li) detector in the energy region 70 keV to 2 MeV. (auth)

23351 ENHANCEMENT OF THE CHARGE RESOLUTION OF LEXAN APPLYING UV-IRRADIATION. Siegmon, G.; Bartholomea, K. P.; Enge, W. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Nucl. Instrum. Methods; 128: No. 3, 461-472(15 Oct 1975).

In this experiment a new technique to improve the charge resolution of Lexan-polycarbonate plastic has been used. Applying

ultraviolet irradiation an increase of the charge resolution was obtained by a factor of three. The method and the technical equipment are described in detail. For an individual iron particle a resolution of 0.1 charge units has been achieved. Data from measurements on the composition of cosmic rays with $Z \geq 8$ and energies between 150 to 400 MeV/nucl, are presented. The analysis is based on the measurement of 193 heavy particles stopping in a stack of 18 Lexan sheets, which was flown at an altitude of 1.8 g/cm^2 for 10 h from Fort Churchill. In 500 cm^2 of this detector package the estimation $(0.13 \pm 0.06) \leq Mn/Fe \leq (0.25 \pm 0.09)$ has been obtained at the point of measurement. (NL)

23352 MEASUREMENT OF ^{55}Fe FROM NUCLEAR FALLOUT IN MARINE SEDIMENTS AND SEAWATER. Labeyrie, L. D.; Livingston, H. D.; Gordon, A. G. (Woods Hole Oceanographic Institution, Mass. (USA)). Nucl. Instrum. Methods; 128: No. 3, 575-580(15 Oct 1975).

An improved windowless gas-flow proportional X-ray detector has been used to make more sensitive and convenient measurement of nuclear fallout-derived ^{55}Fe in freshwater and marine sediments. The iron extracted from a sediment is radiochemically purified and a part (about 500 mg) electroplated on an area (200 cm^2) of the inside wall of a copper cylinder. The cylinder in turn becomes the cathode of the X-ray detector. A specially designed anticoincidence multi-electrode gas-flow proportional detector surrounds the X-ray detector and reduces its background in the Mn X-ray region to 0.09 counts/min keV. The detection sensitivity (precision ± 50%) for the measurement of ^{55}Fe in typical sediments is around 16 distintegrations/min kg of dry sediment. (NL)

23353 NEGATIVE-IMPEDANCE SEMICONDUCTOR-DETECTOR BIAS SUPPLY. Brendle, M.; Enge, R. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Instrum. Methods; 129: No. 1, 279-282(1 Nov 1975).

A bias supply for up to eight surface-barrier detectors is described. It stabilizes the detector bias voltages against changes of the load-resistor voltage drops. The detector currents are limited. Excessive detector currents produce alarm signals, which are suitable to induce program interrupts of an on-line computer. After a line-power failure the bias voltages remain down until they are switched on again manually. (NL)

23354 RADIOGRAPHIC EXAMINATION OF IRRADIATED IN-CORE NEUTRON DETECTORS. Boeck, H.; Zeilinger, A. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 129: No. 1, 147-154(1 Nov 1975).

For the non-destructive investigation of irradiated in-core neutron detectors neutron-radiography has been applied. Both by direct and indirect methods a good resolution for critical detector parts was achieved. With these two methods irradiated self-powered neutron detectors with Co-, Er-, Hf- and Pt-emitters and a miniature fission chamber were investigated thus revealing the limits of conventional radiography compared to neutron-radiography when highly active objects are investigated. (NL)

23355 HIGH EFFICIENCY γ-RAY METAL CONVERTERS. Shafrir, B.; Seidman, A. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Shimoni, U. (Tel Aviv Univ. (Israel)). Nucl. Instrum. Methods; 129: No. 1, 177-186(1 Nov 1975).

A new type of metal converter formed in a manner which enables γ-photons irradiation in parallel to the effective layer is presented. The photoelectron emission probability and the total conversion efficiency were calculated as a function of the parameters governing the efficiency. Results of the calculations for γ-photon energies of 100-500 keV are shown and properties of materials suitable for converters are discussed. It is shown that total conversion efficiency of about 40% can be achieved in this energy range. (NL)

23356 ULTRA THIN ΔE−E COUNTER TELESCOPE WITH POSITION SENSITIVITY IN TWO DIMENSIONS. Markham, R. G.; Austin, S. M.; Laumer, H. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Instrum. Methods; 129: No. 1, 141-145(1 Nov 1975).

A thin-window proportional counter (ΔE)-Si surface barrier detector (E) telescope is described which has position sensitivity in two dimensions with a resolution of < 0.40mm fwhm (σ_{rms} < 0.17 mm). The counter is well suited for particles with E/M = 0.2-5 MeV/amu and is very easy to construct and to use. (NL)

23357 INFLUENCE OF ELECTROSTATIC PRECIPITATORS ON THE BACKGROUND COUNTING RATE OF A SENSITIVE WHOLE-BODY RADIOACTIVITY MONITOR. Parthasarathy, K. S. (Bhabha Atomic Research Centre, Bombay (India)). Nucl. Instrum. Methods; 128: No. 3, 569-572(15 Oct 1975).

Variability of the background counting rate of sensitive γ-ray counters due to changes in the concentrations of the decay products of ^{222}Rn in the shielded space may be reduced by filtering, from the air supply, all decay products by the help of electrostatic precipitators and by maintaining high flow rates of air to prevent build-up of decay products in the shielded space. This paper deals with the influence of a commercially available electrostatic precipitator (Honeywell type H-37) on the background counting rate of a multicrystal wholebody radioactivity monitor. Short-term variation in background counting rate is not likely to affect accuracy of measurements of body burden. But when the counter is used to determine extremely low radioactivity in materials the counting times are large and the changes in background counting rates are significant. Honeywell type H-37 precipitator helps to reduce the concentrations of the decay products of ^{222}Rn. But a part of the natural radioactive aerosols penetrates the precipitator leading to change of background counting rate. Installation of a precipitator alone is not satisfactory. (NL)

23358 TIME-PICK-OFF FROM PULSED BEAM ACCELERATORS. Scheck, W.; Hillers, A.; Labus, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 128: No. 3, 581-582(15 Oct 1975).

The accelerator radio-frequency or time pulses from nuclear radiation detectors are shifted by a voltage-controlled delay unit (VCD) in series with the start or stop input of the time-to-pulse-height converter (TPC). The counting rates of two single channel analysers are compared, whose windows select different areas of the TPC spectrum. A regulation signal is derived for the VCD, to stabilize the center of the spectrum in a closed loop control circuit. (NL)

23359 POLARIMETER FOR STUDYING THE ELASTIC SCATTERING OF POLARIZED FAST NEUTRONS. Galloway, R. B.; Waheed, A. (Edinburgh Univ. (UK)). Nucl. Instrum. Methods; 128: No. 3, 515-522(15 Oct 1975).

The polarimeter described has been designed for use over a wide range of neutron energies to obtain the angular dependence of polarization and the differential cross-section of elastically scattered neutrons. For good efficiency of data collection the asymmetry in the scattering of polarized neutrons is determined simultaneously at 3 scattering angles while adequate monitoring of the neutron flux is provided to enable the differential cross sections to be obtained also. The time-of-flight technique is employed. Examples are provided of the use of the instrument with 3 MeV neutrons from the ^{2}H(d,n) ^{3}He reaction and an associated particle time-of-flight system and with 16 MeV neutrons from the ^{3}H(d,n)^{3}He reaction and a pulsed beam time-of-flight system. (NL)

23360 LOW-LEVEL NEEDLE COUNTER. Fujita, Y.; Taguchi, Y.; Imamura, M.; Inoue, T.; Tanaka, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nucl. Instrum. Methods; 128: No. 3, 523-524(15 Oct 1975).

A small needle type gas counter has been developed for high sensitive β counting of solid sources as weak as 0.01 cpm. (NL)

23361 DETECTION EFFICIENCY AND TRACK DISTRIBUTIONS OF ISOMERIC FISSION FRAGMENTS IN A FISSION-IN-FLIGHT EXPERIMENT. Migneco, E.; Russo, G. (Catania Univ. (Italy). Istituto di Fisica Nucleare); De Leo, R.; Pantaleo, A. (Bari Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 129: No. 1, 207-218(1 Nov 1975).

The detection efficiency and the spatial distribution of the isomeric fission fragments from recoiling nuclei are calculated for a special geometrical configuration of track detectors. The results obtained for isomers produced in the (n,2n) reaction with an incident energy of 14 MeV show that the experimental arrangement allows the determination of decay constants in the range between 0.001 and 1.0 mm^{-1} with an efficiency higher than 20%. The effects of varying the source radius, the angle of the incident particles and the angular distribution of the fragments, as well as the spread in the recoil energy caused by neutron evaporation and isomer slowing-down inside the target, are evaluated. (NL)

23362 THIN INSULATOR CURRENT PULSE COUNTER OF FISSION FRAGMENTS. Klein, N.; Solomon, P. (Technion-Israel Inst. of Tech., Haifa); Tommasino, L. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Lab. di Dosimetria e Standardizzazione). Nucl. Instrum. Methods; 129: No. 1, 119-121(1 Nov 1975).

The use of silicon dioxide capacitors for the detection of fission fragments by current pulses is described. With a capacitor area of 2×10^{-2}cm^2 the pulses were not detectable when the oxide was relatively thin, but with a 3800 A thick oxide fission fragments produced pulses of about 10^{-15}C. The mechanisms producing the current pulses are discussed and the pulses seem to be produced by the ionization spikes. The current pulse counters are simple and compact, can provide very thin timing devices for heavy ions, and may possibly serve as dE/dx detectors. (NL)

23363 ROCHESTER HEAVY ION DETECTOR. Shapira, D.; Devries, R. M.; Fulbright, H. W.; Toke, J.; Clover, M. R. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Nucl. Instrum. Methods; 129: No. 1, 123-130(1 Nov 1975).

A heavy ion detector of novel design has been constructed for use with a magnetic spectrometer. It consists of a gridded, split anode ionization chamber with two position sensitive wire proportional counters. Simultaneous measurements (with resolution) of the total energy (≤1.4% fwhm), energy loss (3%), residual energy (range) (5%) and of the position and angle of incidence at the focal plane for each detected ion allows the determination of the reaction angle, the energy, the atomic number, the charge state and the mass for ions as heavy as A = 40. (NL)

23364 HIGH RESOLUTION POSITION-SENSITIVE PROPORTIONAL COUNTER. Markham, R. G.; Robertson, R. G. H. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Instrum. Methods; 129: No. 1, 131-140(1 Nov 1975).

A counter giving high resolution for lightly ionizing particles incident at 45° has been designed and placed in routine operation in an Enge split-pole magnetic spectrograph. Use of a lumped-constant delay line and inclined cathode pickup stripes results in a very compact unit with high transmission; the collection and readout geometry results in virtual elimination of straggling (energy-loss fluctuations) as a source of resolution degradation. Spectra with total line widths less than 0.25 mm fwhm have been observed with 35 MeV protons. (NL)

23365 AUTOMATICAL SPARK COUNTING OF NEUTRON-INDUCED RECOIL TRACKS IN POLYCARBONATE FOILS. Jasiak, J.; Piesch, E. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Nucl. Instrum. Methods; 128: No. 3, 447-453(15 Oct 1975).

The new approach in automatical track counting of neutron induced recoils in 12μm thin Makrofol KG foils was realized by varying the spark counter voltage and using the voltage at the starting point of the electrical breakdown as a parameter for the counting sensitivity. Based on an optimized etching technique small changes in foil quality, in foil thickness and etching conditions as well as in neutron energy yield a sensitivity of $(0.3 - 2.0) \times 10^{-6}$ sparks per neutron for ^{252}Cf fission and Am-Be neutrons. The reproductivity for consecutive counting, the lower detection limit and the energy dependence have been investigated and compared with microscopical track counting. (NL)

23366 COMSAC AND MONILLE: SAFEGUARDS AND ENVIRONMENTAL SYSTEMS. Minges, G. P.; Chanda, R. N.; Harlan, R. A. (Dow Chemical, U. S. A., Golden, CO). Nucl. Mater. Manage.; 4: No. 3, 480-497(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A calorimeter (COMSAC, Computerized Measurements for Safeguards and Accountability) was built for the assay of plutonium contained in 4-liter packages of waste/scrap residues. The calorimeter is of the twin isothermal design. Design modifications include improved bath control, the use of aluminum sensors instead of copper and a simplified readout technique. Experimentally, the 4-liter calorimeter will detect less than 1 gram of plutonium containing 6 percent ^{240}Pu in a matrix of insulation and has an operating range exceeding 1 kilogram. A monitor (MONILLE, Monitor of Low-Level Effluents) for continuously observing and recording low-level radioactivity in the sanitary sewage at the Rocky Flats Plant was designed and installed. Laboratory tests with ^{239}Pu and ^{241}Am show that the counter will detect these materials at activity concentrations of 1.67×10^{-6} and 6.5×10^{-8} microcuries per milliliter, respectively. Detection at these concentrations requires a 5-minute count of background plus sample to be rejected as background only at a confidence level of 0.998. (auth)

23367 RADIOLUMINESCENCE PRODUCED BY ^{63}Ni. Galli, G.; Serra, M. (Rome Univ. (Italy)). Energ. Nucl. (Milan); 21: No. 5, 291-296(1974).

The results of the measurements of the photometric characteristics of (Zn,Cd)S(Cu) crystals excited by ^{63}Ni β rays are reported. Radiance, luminous flux, and specific efficiency have been determined. The power released by the ^{63}Ni source has been evaluated assuming an exponential attenuation of emitted spectrum. In order to evaluate the influence of internal diffusion and absorption of light on the emitted luminuous flux, the transparency of various thicknesses of phosphorus used has been measured. (INIS)

23368 SOME CONSIDERATIONS IN THE USE OF RADIATION MONITORS FOR PERSONNEL PROTECTION IN AGRICULTURAL RESEARCH WITH RADIOISOTOPES. Visser, C. J.; Haasbroek, F. J. (Fruit and Food Technology Research Inst., Stellenbosch (South Africa)). Agrochemophysica; 6: 83-84(1974).

The results of an investigation on radiation monitors, carried out on three commercially available monitors, which are in daily use in the Fruit and Fruit Technology Research Institute, Stellenbosch, are discussed. These monitors have a metal absorber which can be slid in front of the G.M. counter tube window as an aid to distinguish between β- and γ-radiation. The nuclides ^{32}P, ^{45}Ca, ^{14}C, ^{226}Ra, ^{60}Co, ^{137}Cs were used. (INIS)

23369 INFLUENCE OF LARGE-SCALE TRAPS ON THE PROPERTIES OF SEMICONDUCTOR NUCLEAR-PARTICLE DETECTORS. Eremin, V.K.; Strokan, N.B.; Tisnek, N.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Semicond. 9: No. 8, 1038-1040 (Aug 1975).

There is extensive published literature on the trapping of carriers in semiconductor detectors because the charge losses govern the energy resolution of such detectors. It is shown that the available information can be interpreted by assuming the existence of large-scale technological fluctuations of the potential in the active zone of a detector. These fluctuations appear during the compensation stage (necessary to form the active zone of a detector) and are due to an inhomogeneous distribution of impurities in the original material. This type of analysis is applied to lithium-drifted silicon detectors, radiation-defect-compensated germanium detectors, and detectors made of very pure germanium. (auth)

23370 SECONDARY PROCESSES IN A GAS COUNTER. I. Peskov, V.D. (Institute of Physical Problems, Academy of Sciences of the USSR, Moscow). Sov. Phys.—Tech. Phys. 20: No. 6, 791-794 (June 1975).

The counting plateau for any counter has been shown experimentally to rise with decreasing excitation potential and ionization potential of the filler gas. In nonquenching gases, secondary discharges appear primarily because of resonant radiation and metastable atoms. The spurious pulses caused by this type of radiation can have a delay of the order of 10^{-5}–10^{-4} sec. It is concluded that the leading role in the self-quenching of a discharge in a counter is not played by the dissociation of the impurity molecules in their neutralization at the cathode, as is customarily assumed, but by the low ionization potential of the additive gas and the absence of resonant radiation. (auth)

Radiation Dosimeters

Refer also to abstracts 23155 and 24998.

23371 (AECL-5309) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1975. 76p. Dep. NTIS (US Sales Only) $5.00.

Separate abstracts were prepared for four sections of this report. (CH)

For abstracts of individual sections see: 23264, 23372, 23504, and 23580.

23372 (AECL-5309, pp 9-25) HEALTH PHYSICS BRANCH. Cowper, G. Nov 1975.

In Biology and Health Physics Division progress report, July 1–September 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.).

Studies on fast neutron dosimetry, thermoluminescence dosimetry, environmental γ monitoring with a silicon detector, amplifying radiation detectors, safeguards instrumentation, tritium monitoring, energy loss in thin films, atmospheric diffusion studies, detection of ^{131}I in air, and routine dose monitoring are briefly reported. (WHK)

23373 (CONF-740701-, pp 321-327) PASSIVE ENVIRONMENTAL NEUTRON DOSIMETER. Apt, K. E.; Schiager, K. J. (Los Alamos Scientific Lab., NM). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

A passive environmental neutron dosimeter was developed for use in the environs of the Clinton P. Anderson Meson Physics Facility. The dosimeter is a 0.25-m-diam spherical polyethylene moderator which incorporates 2 fission-fragment track registry assemblies. Enriched ^{235}U serves as the fission radiator, and 10-mu m-thick polycarbonate foil is the fission-track registry material. Latent fission tracks are chemically etched with base and subsequently counted with an automatic digital spark counter system. The neutron dosimeter is insensitive to radiation other than neutrons, and an exposed registry foil becomes a permanent record of integrated neutron dose equivalent. The dosimeter response is approximately proportional to the incident neutron dose equivalent. Calibration and field exposures indicate that dose equivalent values as low as 0.1 mrem can be accurately measured.

The environmental neutron dosimeter in conjunction with thermoluminescent dosimetry materials has been used to characterize environmental radiation levels resulting from nuclear accelerator operations.

23374 (CONF-741040-P2, pp 65-85) RADIATION DOSIMETRY WITH THIN FILMS. McLaughlin, W. L. (National Bureau of Standards, Washington, DC). 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

A thin self-supported or laminated layer of radiation-sensing material is useful for measuring or monitoring the energy deposited by a radiation beam passing through that layer. If (1) the film is thin enough in relation to the range of the incident radiation particles in the absorbing material and (2) the incident radiation spectrum can be approximated sufficiently, the absorbed dose or dose rate in materials surrounding the thin layer can be determined by applying fairly simple cavity-theory considerations (i.e., factoring by stopping power ratios in the case of charged-particle beams). Some sensing materials that may be used as dosimeters in accelerator beams are thin calorimetric bodies, solid-state detectors, and ceramic, plastic, or dyed plastic layers. Major sources of error that must be accounted for are instabilities, non-linearities, variations of response with dose-rate and spectral changes, environmental factors, inconsistencies in the quality of the sensing material, and imprecisions in the analysis of the radiation effect. A primary advantage afforded by thin-film dosimetry is its capability of supplying dose distribution data near interfaces of different materials.

23375 CHARACTERISTICS OF MINIATURE DOSIMETER DEVELOPED FOR MEASUREMENT OF BREMSSTRAHLUNG. Maruhashi, A.; Sasaki, S.; Hyodo, T. (Kyoto Univ. (Japan). Faculty of Engineering). Nucl. Instrum. Methods; 128: No. 3, 441-446(15 Oct 1975).

The report describes characteristics of the miniature dosimeter which was developed for the measurement of the exposure rate of bremsstrahlung and of the absorbed dose. This dosimeter is very easily used without applied bias voltages and is very cheap. It is a silicon diffused $n\text{-}p^+$ junction device. The silicon detecting element of this dosimeter has the form of a disk, 1.5 mm in diameter and 0.2 mm long, which is covered with 1 mm thick copper. The bremsstrahlung was produced in a gold target bombarded by 0.6 to 1.8 MeV electron beams from a Van de Graaff accelerator. The radiation-induced current was proportional to the exposure rate of bremsstrahlung over the range of 10^2 to 10^6 R/h and was independent of the electron energy incident on the gold target, and of the room temperature. This dosimeter gave a current of $(1.40 \pm 0.05) \times 10^{-3}\mu A(R/s)$. The depletion-layer thickness of this dosimeter and the absorbed dose in the silicon detecting element per roentgen were found by calculation to be ~79.0 μm and 1.3 Rad/R. Using these values 0.96 Rad was obtained as the absorbed dose in silicon per roentgen of bremsstrahlung under charge particle equilibrium. (NL)

23376 COMPUTATIONAL EXTENSION OF THE DYNAMIC RANGE OF TL AND TSEE READERS. Jun, J. S.; Talmage, J. E.; Becker, K. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Instrum. Methods; 129: No. 1, 247-250(1 Nov 1975).

In situations in which the measurability of thermoluminescence or exoelectron emission glow curves is limited by the characteristics of the readout instrument (e.g., saturation in proportional or gas counters), the peak can be "reconstructed" as if it were recorded in full by proper evaluation of the reliably recorded low-T and high-T segments of the peak. The results of two different methods have been compared, assuming (a) a Gaussian shape or (b) linear scaling of the glow curves, with a parabolic shape at the low-T and a linear shape at the high-T side. The procedures are simplified by using the combination of a digitizer and a programmable calculator. The usable dynamic range of various radiation dosimeters can thus be extended by about two orders of magnitude. (NL)

23377 ENVIRONMENTAL MONITORING POST FOR THERMOLUMINESCENT DOSIMETERS. Hsu, P. C. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 3, 163-169(Sep 1975).

Various factors involved in the plastic tubing as the environmental monitoring post for thermoluminescent dosimeters were studied and compared with the bamboo post which is in use now. The experiment revealed that a 1 m long and 3 in. diam. plastic tube 5.5 mm thick with 70 holes of $\frac{1}{16}$ in. diam. per 100 square centimeter is the optimum size for a monitoring post. (auth)

23378 LONG-TERM DOSIMETRY. Morgan, W. C. (Pacific Northwest Labs., Richland, WA). J. Test. Eval.; 3: No. 3, 217-219 (May 1975).

From ASTM minisymposium on neutron dosimetry and spectrum analysis for materials applications; San Diego, CA (3 Dec 1974).

It should be assumed that the shape of the neutron energy spectrum and the neutron flux intensity will change during a long-term materials irradiation. The neutron dosimetry effort should have three primary goals: (1) dosimetry should be concentrated on the range of neutron energies of most importance for the radiation damage process; (2) the effective half-lives of the dosimeters should be less than the irradiation duration; and (3) appropriate corrections should be made for changes in the neutron spectrum and flux intensity during the irradiation. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 22897, 24662, 24697, and 24879.

23379 (HMI-B-173) DATA RECORDING PROGRAMME FOR A TIME-OF-FLIGHT NEUTRON SPECTROMETER. Smit, J. G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). Apr 1975. 44p. (In German). INIS.

15 figs.; 23 refs.

A modular program was written for the acquisition of the measurement data of a rotating crystal neutron spectrometer in a PDP-11/20 computer (16 K core memory). The modules are subroutines called by the higher-order FORTRAN programs. This program, which is carried out under the version 08/02 disk operation system, collects the data of a maximum number of 7 detectors in the core memory via interrupts in the on line mode. The detectors are connected to a time-of-flight unit which assigns the time and the detector number to the signals (minimum width of time channel 0.5 μs). From the T.O.F. unit the signals are passed on to the computer via a CAMAC input register and the CA-11 a branch driver manufactured by DEC. All the measurement data can be graphically displayed on a Tektronix visual display unit (keyboard interrupt). Relevant data are stored on disk and passed on to the central computer (S 4004) for further processing at the end of the experiment. (DE)

23380 (RD/B/N-3443) SPECTROSCOPY SECTION DATA ACQUISITION SYSTEM AT CEGB, BERKELEY NUCLEAR LABORATORIES. Swallow, G. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1975. 17p. Dep. NTIS (US Sales Only) $3.50.

The first version of a software package designed to take data from the various instruments in the spectroscopy section is described. It describes the program philosophy, the instruments serviced, and contains a comprehensive guide to the use of the program. The system operates on a Varian 620L minicomputer and data can be output in a form suitable for further analysis on the IBM 370 computer if necessary. (auth)

23381 (UCRL-5007-75-1, pp 10) INSTRUMENT DEVELOPMENT: IMPROVED ELECTRONICS CONFIGURATION FOR LLL NEUTRON SPECTROMETER SYSTEM. 15 Aug 1975.

In hazards control progress report No. 50, January–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Progress on instrument development at LLL is described. Projects covered include: improved electronics configuration for LLL neutron spectrometer system; development of a high resolution neutron spectrometer for field use; modified chlorine and hydrogen chloride cartridge testing system; and a portable gamma spectrometer. (GHT)

23382 (UCRL-5007-75-1, pp 36-38) INSTRUMENT DEVELOPMENT: CALIBRATION OF PROPORTIONAL COUNTERS FOR NEUTRON SPECTROMETER. 15 Aug 1975.

In hazards control progress report No. 50, January–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Calibration of the LLL neutron spectrometer system is described. The characteristics of the proportional counters used with the instrument have been determined with respect to: neutron detection efficiency; pulse height resolution as a function of anode voltage; and gas multiplication factor as a function of anode voltage. (GHT)

23383 VERSATILE MULTIPOLE CORRECTION MAGNET OF RECTANGULAR APERTURE. Peterson, R. J.; Kraushaar, J. J.; Ristinen, R. A. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.); Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)); Rickey, M. E. (Indiana Univ., Bloomington (USA). Dept. of Physics). Nucl. Instrum. Methods; 129: No. 1, 47-51 (1 Nov 1975).

A rectangular aperture multipole magnet in which multipole components are independently variable has been designed and constructed. This magnet is intended for use as an adjustable trim element in a precision spectrometer system. No organic materials are used in the assembly, and the magnet is suitable for use in a high radiation environment. (NL)

23384 DEVELOPMENT OF COMPUTER-ANALYZER FOR NUCLEAR PULSE ANALYSIS. Patwardhan, P. K.; Misra, V. M.; Chand, G.; Mathur, R. (Bhabha Atomic Research Center, Bombay). pp 263-267 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Hardwired multichannel analyzers (MCA), although suitable as fast data acquisition systems inherently do not possess the capability for arithmetic operations on raw data. Also flexibility is limited due to the limited wired functions. An attempt is made to develop a computer-analyzer system built around an 8K, 16bit TI960A processor having time sharing capability. Initially, a 1K, 50 MHz. MCA has been interfaced to the processor which itself is connected through its I/0 channel to a teletype and an interactive CRT display with keyboard. An independent CRT display also connected to the computer provides the graphical output to monitor the spectra gathered on the MCA so as to ensure the proper functioning of all interfaces. In phase two, multiple A/D Converters can be connected to the machine on a priority interrupt basis. Fast access devices viz. magnetic tapes, discs can be connected through the DMA Channel. Simple programs for analysis of spectra are being developed using this system.

23385 DETECTION OF PROMPT DEEXCITATION γ-RAYS FOLLOWING BREMSSTRAHLUNG-INDUCED REACTIONS WITH THE AID OF LARGE VOLUME Ge(Li) DETECTORS. Berg, U. E. P.; Wolf, H.; Schaefer, B.; Wienhard, K. (Giessen Univ. (F. R. Germany). Abt. Grossgeraete (Angewandte Kernphysik)). Nucl. Instrum. Methods; 129: No. 1, 155-165(1 Nov 1975).

An experimental arrangement at the bremsstrahlung beam of a 65 MeV electron linac has been optimized with regard to the detection of prompt deexcitation γ-rays from small target quantities by Ge(Li) detectors. The 100 cm^3 Ge(Li) diodes have been calibrated by means of radioactive sources and radiative proton capture reactions. The influence of counting rate effects and background radiation during the bremsstrahlung burst are discussed. Deexcitation photon spectra from $^{28}Si(\gamma,\gamma')$, $^{25}Mg(\gamma,x\gamma')$ and $^{31}P(\gamma,x\gamma')$ reactions are presented. (NL)

23386 BROAD-RANGE ON-LINE ELECTRON SPECTROMETER. Konijn, J.; Posthumus, W. L.; Goudsmit, P. F. A.; Schiebaan, C.; Geerke, H. P.; Maarleveld, J. L.; Andringa, J. H. S.; Evers, G. J. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Nucl. Instrum. Methods; 129: No. 1, 167-175 (1 Nov 1975).

Special features of a broad-range high-transmission electron spectrometer, incorporating a solenoid and a Si(Li) detector are described. The source-detector distance is 72 cm. A detector vacuum-lock system makes it possible to maintain the Si(Li) diode at liquid-nitrogen temperature during installation and choose an optimum detector position with respect to the magnetic field. A baffle to separate electrons from positrons is described. A brief presentation is given of a cleaning procedure for Si(Li) diodes. An absolute efficiency of 11% of 4π for 481 keV electrons is measured employing a 3 mm thick, 110 mm^2 detector. The resolution is 1.3 keV and 2.0 keV fwhm at 92 keV and 975 keV electron energies, respectively. The time spectrum between conversion electrons measured in the solenoid and γ-rays measured with a large-volume Ge(Li) detector shows a slope of a few nanoseconds. (NL)

23387 IDENTIFICATION AND SPECTROMETRY OF CHARGED PARTICLES PRODUCED IN REACTIONS INDUCED BY 14 MeV NEUTRONS. II. Sellem, C.; Perroud, J. P.; Loude, J. F. (Lausanne Univ. (Switzerland). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 128: No. 3, 495-503(15 Oct 1975).

A counter telescope consisting of gas proportional counters, a thin semiconductor detector and a thick one has been built and used for the study of the angular differential cross sections of (n, charged particles) reactions induced by 14 MeV neutrons. Detection of the α-particles emitted in the neutron production reaction $^3H(d,n)^4He$ gives a time reference for the measurement of the time of flight of the charged particles and allows a precise monitoring of the neutron beam. High energy protons, deuterons and tritons are identified by their energy losses in the thin semiconductor detector and in the thick one and by their time of flight. Low energy protons, deuterons, tritons and all α-particles stop in the thin semiconductor detector and are identified by their energy losses in this detector and in one gas proportional counter as well as by their time of flight. It is possible to identify and to measure the energy of all charged particles in the energy range of 2 to 15 MeV: a very low background results from the use of the time of flight. (NL)

23388 FRENCH NEUTRON AND γ RAY DETECTOR SIGNE I, LAUNCHED ABOARD THE SOVIET SATELLITE PROGNOZ II. Albernhe, F.; Cassignol, M.; Cotin, F.; Doulade, C.; Talon, R.; Vedrenne, G. (Toulouse-3 Univ., 31 (France). Centre d'Etude Spatiale des Rayonnements). Nucl. Instrum. Methods; 129: No. 1, 295-301(1 Nov 1975).

The Signe 1 experiment was designed to measure intensity, energy distribution and time variations for solar γ rays between 0.35 and 11.8 MeV and solar neutrons between 1.1 and 19.3 MeV respectively. The detector consists of a 1.5×1.5 inch stilbene scintillator associated with a ruggerized photomultiplier. This is mounted inside a plastic anticoincidence shield, viewed by a phototube, in order to eliminate the charged cosmic ray component. The pulses created by neutrons and γ radiation are separated in the stilbene by means of pulse shape discrimination. The spectrometry is carried out in 6 channels for γ rays with a time resolution of 41 s and in 3 channels for neutrons with a time resolution of 164 s or inversely with an alternate mode. Integral rate of the shield scintillator is monitored above a threshold set at 300 keV. Logic and binary circuits provide scaling and storage for each channel and also logarithmic digital-to-analog conversion for the spacecraft telemetry. (NL)

23389 NEW PEAK SEARCH METHOD FOR AN AUTOMATIC SPECTRUM ANALYSIS PROGRAM. Blok, H. P.; De Lange, J. C.; Schotman, J. W. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Nucl. Instrum. Methods; 128: No. 3, 545-556(15 Oct 1975).

A new method for the automatic identification of peaks in a spectrum has been devised. A region centered on each channel i of the spectrum is fitted by a peak of given shape superimposed on a constant background. A maximum as a function of i in the height of the fitted peak is used to indicate the presence of a peak in the spectrum. Close-lying doublets and triplets that are resolved by other methods can be found using this method. The sensitivity of the method to small peaks and to fluctuations in the background has been investigated. Together with a least-squares peak fitting routine using the Marquardt algorithm, the peak search subroutine forms an automatic spectrum analysis program, which has been used extensively for the analysis of charged particle and γ-ray spectra. The peak shape used for these spectra consists of a Gaussian in the top, an exponential on the right-hand side and a double exponential on the left-hand side. Several examples of analyzed spectra used for a test of the search and fitting methods are presented together with a discussion of the errors in the fitted parameters. (NL)

23390 NEW IRON-CORE MAGNET β SPECTROMETER WITH $\Delta p/p = 8 \times 10^{-5}$. Mampe, W.; Jeuch, P.; Von Egidy, T.; Schreckenbach, K.; Braumandl, F.; Larysz, J. (Institut Max von Laue-Paul Langevin, 38-Grenoble (France)). Nucl. Instrum. Methods; 128: No. 3, 585-589(15 Oct 1975).

A new iron-core magnet β spectrometer has been constructed at the High Flux Reactor in Grenoble. It is used for conversion electron measurements. The mean radius is r = 50 cm. Double focusing is achieved by the combination of homogeneous and 1/r fields. A momentum resolution of $\Delta p/p$ (fwhm) $= 8 \times 10^{-5}$ has been measured. The properties of the new spectrometer are compared with other high resolution instruments. (NL)

23391 NEW GAIN EQUATION FOR MULTICHANNEL PULSE ANALYSIS. Gleason, G. (Oak Ridge Associated Universities, TN). Radiochem. Radioanal. Lett.; 23: No. 4, 221-223(29 Nov 1975).

A model of the form E equals $a + bx + c/x^2$ is proposed as a better mathematical relationship for equating energy to channel number in multichannel spectrometry when nonlinearities are known to exist in the lower channels. (auth)

23392 NEUTRON SPECTRUM ANALYSIS FROM DOSIMETRY EXPERIMENTS. Kam, F. B. K. (Oak Ridge National Lab., TN); Stallmann, F. W. J. Test. Eval.; 3: No. 3, 211-216(May 1975).

From ASTM minisymposium on neutron dosimetry and spectrum analysis for materials applications; San Diego, CA (3 Dec 1974).

A fairly good approximation to a neutron spectrum can be obtained commensurable with the accuracy of the activity and cross-sectional measurements. However, these approximations are valid only in regions where the coverage is determined by the cross sections and spectrum used and may be locally disturbed

by poor resolution. Coverage and resolution are two properties which determine the goodness of a given monitor set. The trial spectrum influences the outcome of the unfolding only to the extent that the monitor set fails to provide the necessary coverage and resolution. (auth)

High Energy Physics Instrumentation

23393 (BNL-20784) MPS DATA ACQUISITION SYSTEM. Eiseman, S. E.; Miller, W. J. (Brookhaven National Lab., Upton, N. Y. (USA)). 25 Sep 1975. vp. Dep. NTIS $5.50.

A description is given of the data acquisition system used with the multiparticle spectrometer facility at Brookhaven. Detailed information is provided on that part of the system which connects the detectors to the data handler; namely, the detector electronics, device controller, and device port optical isolator. (GHT)

23394 (ERDA-tr-121) TRACK OF THE NEUTRINO. Fedorov, R. 15 Jan 1976. Translation of Sled Neitrino, Pravda, Moscow, 1976. 5p. Dep. NTIS $3.50.

The SKAT heavy-liquid bubble chamber for neutrino detection at Serpukhov is briefly described. SKAT is filled with freon bromide. (WHK)

23395 (LBL-4624) FOUR-DEEP CHARGE-TIME AND PULSE-WIDTH SCALING DISCRIMINATOR FOR DELAY LINE MWPC's. Lee, K. L.; Kirsten, F. A.; Grigorian, A.; Guiragossian, Z. G. T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-eng-48. 5p. (HEPL-4624; CONF-751116-33). Dep. NTIS $3.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A discriminator has been developed for digitizing both intercepted total charge and location of electromagnetic shower and particle trajectories in multi-wire proportional chambers read by delay lines. Determination of shower trajectory is aided by video signal integration followed by centroid-locating discrimination. Calibrated run-down of the signal integrating capacitor gives the charge information above a given threshold level. The discriminator is designed to handle up to four shower-induced video signals per event by incorporating steering circuits within the module. Each video signal is examined for time over an adjustable threshold. Video pulses with separation of less than 20 nsec are treated as a single pulse. Counter-logic circuits indicate the number of video signals digitized. These signal processing circuits provide a first level of data sifting which otherwise must be carried out with additional discriminator channels and added complexity in data recognition.

23396 (ORNL/TM-5105) CALCULATED PERFORMANCE OF IRON–ARGON AND IRON–PLASTIC CALORIMETERS FOR INCIDENT HADRONS WITH ENERGIES OF 5 TO 75 GeV. Gabriel, T. A.; Schmidt, W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 43p. Dep. NTIS $5.50.

The calculated responses of iron–argon and iron–plastic calorimeters for incident hadrons with energies of 5 to 75 GeV are presented. The responses calculated are energy resolution vs energy, energy resolution vs the thickness of the sampling plates, the angular and spatial root-mean-square deviations (i.e., the ability to determine the incident particle's entrance angle and impact point), and the spatial properties of the average and individual hadronic cascades. Some comparisons are made with experimental data; however, the main purpose of this paper is to provide specific design information for these types of calorimeters.

23397 (RI-75/5) INTERVENING PROBLEMS DURING THE IDENTIFICATION OF PARTICLES BY THE CHERENKOV EFFECT. Efficiency of the Triggering System Used in the "Fast Proton" Experiment with the Omega Spectrometer. Roudeau, P. (Paris-11 Univ., 91 – Orsay (France)). Jun 1975. 138p. (In French). Dep. NTIS (US Sales Only) $10.00.

Thesis.

The results of a detailed study of the characteristics and performances of the high pressure Cherenkov detector at CERN are reported. There was good agreement between the predictions by a Monte Carlo program and those obtained by simple calculations on the behavior of particle jets having very low angular and momentum spreads. The importance of the concept of geometric expanse for a light beam being received by the detector is shown. The examination of the total efficiency of the triggering system, data acquisition system, and track reconstruction program has shown the high quality of this total chain. The good constance of the azimuthal spectrum of the fast track assures the absence of skews. The acceptance curves for the largest transverse pulses are well described by geometrical limitations. (JSR)

23398 COMPARISON OF DRIFT CHAMBERS. Becker, U.; Burger, J. D.; Forber, R.; Leong, J. (Massachusetts Inst. of Tech., Cambridge (USA)); Perasso, L. (Harvard Univ., Cambridge, Mass. (USA)). Nucl. Instrum. Methods; 128: No. 3, 593-595(15 Oct 1975).

A new drift chamber suitable for large area detectors is compared to a multiwire field shaped module. The behavior of both is understood from their electrostatic field and the predicted behavior for inclined tracks correctly verified by measurement. (NL)

23399 X-RAY TRANSITION-RADIATION YIELD DEPENDENCE ON THE PARAMETERS OF A STACK OF PLATES. Avakian, A. L.; Garibian, G. M.; Yang, C. (Erevanskij Fizicheskij Inst. (USSR)). Nucl. Instrum. Methods; 129: No. 1, 303-306 (1 Nov 1975).

The dependence of the number of quanta of the X-ray transition radiation produced in a single plate and stack of plates on the thickness of the plates and plate spacing is investigated. The calculation of the number of quanta is carried out for fixed frequency as well as for certain frequency intervals at various values of the charged-particle Lorentz factor. (NL)

23400 RADIAL PROPERTIES OF ELECTRON SHOWERS. Lederman, L. M.; Vidal, R. A. (Columbia Univ., New York (USA)). Nucl. Instrum. Methods; 129: No. 1, 65-71(1 Nov 1975).

A MWPC was installed between a 1 rad length converter and a lead glass shower detector in order to investigate the possibilities of improved hadron rejection and the various implications of spatial resolution. The energy range studied was 3 to 6 GeV incident pions and electrons. (NL)

23401 OPTIMAL CHOICE OF THE LAMINAR MEDIUM SUBSTANCE FOR ULTRARELATIVISTIC PARTICLE TRANSITION RADIATION DETECTORS. Avakian, A. L.; Garibian, G. M.; Yang, C. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). Nucl. Instrum. Methods; 128: No. 3, 601-602(15 Oct 1975).

The dependence of the X-ray transition yield in the energy region 10-20 keV produced by an ultrarelativistic charged particle in various laminar media on the substance of the plates is investigated in detail. It is shown that in this case beryllium is the most optimal substance. Other energy regions of transition radiation quanta are also considered. (NL)

23402 METHOD FOR PRODUCING AN INSENSITIVE REGION IN A MULTIWIRE PROPORTIONAL CHAMBER. Crittenden, R. R.; Krider, J. C. (Indiana Univ., Bloomington (USA). Dept. of Physics). Nucl. Instrum. Methods; 128: No. 3, 599(15 Oct 1975).

A simple method is described for producing an insensitive area in a multiwire proportional chamber. Test results are presented. (NL)

23403 PORTABLE SPARK-CHAMBER RANGE SPECTROMETER AND DATA ACQUISITION SYSTEM. Baldwin, A. R.; Madey, R. (Kent State Univ., Ohio (USA). Dept. of Physics). Nucl. Instrum. Methods; 129: No. 1, 257-277(1 Nov 1975).

A portable spark-chamber range spectrometer and electronic data acquisition system is described for acquiring spectral data on energetic charged particles. The instrument system consists of a uni-directional spark-chamber range telescope with pulse-height analysis of the specific loss (dE/dx) of a charged particle that passes through a triggering telescope. The range telescope consists of a stack of sealed double-gap spark-discharge modules with absorbers sandwiched between them. A Chrenkov counter discriminates against electrons and muons. Cherenkov and dE/dx signals are gated by the coincidence circuit. Data, either telemetered or recorded in situ, include the number of coincidences, a clock signal, system voltage levels, and the dE/dx, Cherenkov, and spark-discharge module signals. (NL)

23404 SMALL DATA ACQUISITION AND PROCESSING SYSTEM (DAPS). Dadian, A. T.; Nanasian, A. S.; Zverev, A. M. (Erevanskij Fizicheskij Inst. (USSR)). Nucl. Instrum. Methods; 129: No. 1, 193-197(1 Nov 1975).

The on-line system at the Yerevan Electron Synchrotron comprises PDP-9 and PDP-8/e computers and was devised and used for the acquisition and preprocessing of experimental data and the measurement of track chamber films. In this system PDP-8/e serves as both the front-end processor and the buffer data storage between the system and the users or larger computers. A functional diagram of the system is given and the software is described. (NL)

23405 HIGH VOLTAGE PARTITIONING FOR PHOTOMULTIPLIER PARTICLE DETECTORS. Coli, M. (Comitato Na-

zionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nucl. Instrum. Methods; 129: No. 1, 95-103(1 Nov 1975).

A manual and computer controlled system to vary independently the high voltage supply of a set of 100 photo multipliers inserted in an experimental apparatus for high energy physics research is described. (NL)

23406 CHERENKOV THRESHOLD-DIFFERENTIAL SPECTROMETER. Dibianca, F. A.; Dunaitsev, A. F.; Kolganov, V. Z.; Mukhin, A. I.; Nezrick, F. A.; Sittler, F. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Instrum. Methods; 129: No. 1, 59-63(1 Nov 1975).

A new type of threshold-differential Cherenkov spectrometer has been developed to measure the flux and momentum distribution of high intensity charged particle beams in an intense charged particle background. The spectrometer is intended primarily for use in monitoring and measuring the properties of wide-band neutrino beams by measuring the associated decay muon spectrum. The spectrometer has been tested in a beam of 300 GeV/c protons and found to have 8 percent momentum resolution, 2 mrad angular resolution and 0.1 percent efficiency. (NL)

23407 400 GeV SHOWER COUNTER. Knauer, J. P.; Yount, D. E. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Nucl. Instrum. Methods; 129: No. 1, 91-94(1 Nov 1975).

Specifications and test data are given for a lead-scintillator electromagnetic shower counter used to detect beam photons at Fermi National Accelerator Laboratory. The response is independent of beam position to ± 1.4 percent rms over a 25 x 25 cm area. Shower penetration losses reach 4.1 percent at 250 GeV but are easily calculable. The resolution is limited almost entirely by fluctuations in the number of shower tracks samples: The full-width-at-half-maximum is approximately 43 percent E/sup $^1/_2$/, where E is the incident energy in GeV. (NL)

23408 DEVELOPMENT OF MICROWAVE DISCHARGE SPOTS IN NEON AND HELIUM GAS BY SUBMICROSECOND PULSES. Kustom, R.L.; Fuja, R.E. (Argonne National Laboratory, Argonne, Illinois 60439). J. Appl. Phys. 47: No. 2, 498-504 (Feb 1976).

Microwave discharges were developed in pure neon, pure helium, and 90%-10% neon-helium gas around the trajectory of high-energy charged particles by applying submicrosecond pulses shortly after the passage of the particle. The pulse width and amplitude of the discharge field were varied so that the effect on the discharge spot development could be observed. All measurements were made at room temperature and atmospheric pressure. The discharge chamber is a partially dielectric-loaded waveguide operating in the TEM mode at 1300 MHz so that the discharge fields are uniform over the gas volume. (auth)

Radiometric Instruments

Refer also to abstract 25000.

23409 (CONF-741040-P2, pp 166-173) NEUTRON ACCELERATOR WELL LOGGING. Hilchie, D. W. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

Petroleum well logging using neutron borehole accelerators is reviewed. Since the introduction of the borehole neutron accelerator in 1959, several generations of logging instruments have been developed. These tools measure neutron lifetime, neutron activation based on half life and radiation intensity of the activation products, and capture gamma ray spectroscopy. The borehole instruments used, the effects of transmitting data over long cables, and the extreme operation environments encountered are discussed. The first commercial use of the pulsed neutron generator in boreholes was the measurement of macroscopic thermal neutron absorption capture cross section. Elemental analysis of basic rock constituents has been performed. The latest commercial application is the carbon oxygen log in which gamma ray spectroscopy is used to detect the carbon oxygen ratios in formations to determine the existence of oil in fresh water sands. Field examples of logs and/or measurements involved in these determinations are included.

23410 IN SITU ANALYSIS OF SEDIMENTARY POLLUTANTS BY X-RAY FLUORESCENCE. Wogman, N. A.; Rieck, H. G.; Kosorok, J. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nucl. Instrum. Methods; 128: No. 3, 561-568 (15 Oct 1975).

A prototype energy-dispersive, x-ray fluorescence analyzer has been tested which provides in situ analysis for upwards of 30 elements in the 20 to 50 ppM range in the top millimeter of sediment at water depths to 100m. The prototype analyzers consists of a ^{109}Cd excitation source and a solid cryogen-cooled Si(Li) x-ray detector with a 10 mil. Be entrance window. Details of the irradiation source, the detector, possible future improvements and the actual in situ spectra of marine and freshwater sediments are discussed with respect to the detection of pollutants at existing environmental concentrations. The observed spectra demonstrate the feasibility of using x-ray fluorescence analysis for the in situ measurement of several pollutant elements. (NL)

23411 METHOD FOR IMPROVING THE PERFORMANCE OF X-RAY FLUORESCENCE ANALYSIS SYTEMS AT HIGH COUNT RATES. Desi, S. (Eotvos Lorand Fizikai Tarsulat, Budapest (Hungary)). Nucl. Instrum. Methods; 128: No. 3, 603-605(15 Oct 1975).

A method has been developed to eliminate the processing of the scattered exciting radiation. Results at high count rates indicate significant improvement both in measuring time and energy resolution. (NL)

23412 EXPERIENCE IN APPLICATION OF X-RAY RADIOMETRIC LOGGING IN ONE OF THE TIN ORE FIELDS IN KIRGHIZIA. Afanas'ev, A. V.; Ryzhkov, I. A.; Sukhno, A. N.; Tikhonov, A. I.; Ushan, V. S.; Shvartsman, Yu. G.; Shibkov, V. S.; Yudakhin, F. N. Ekspress-Inf., Ser.: Reg., Razved. Prom. Geofiz.; No. 11, 25-31(1974). (In Russian)

1 fig.; 1 table.

The results of using x-radiometric logging for quantitative determination of tin at a Kirghiz tin ore deposit are considered. Information from comparison of logging data with results of core sampling is presented. (tr-auth)

23413 NUCLEAR-GEOPHYSICAL MEASURINGS OF DENSITY PARAMETERS OF THE MARINE BOTTOMSET BEDS. Babinets, A. E.; Zvol'skij, S. T.; Molchanovskij, S. N.; Vovk, P. K. (AN Ukrainskoj SSR, Kiev. Inst. Geologicheskikh Nauk). Geol. Zh. (Russ. Ed.); No. 6, 41-50(1974). (In Russian)

6 refs.; 5 figs.; 1 table.

The development of a method and apparatus for nuclear-geophysical measurements of the density parameters of sea bottom locations, using a gamma-gamma wide-beam method which permits using weak gamma sources, is presented. Since there is no strict analytical theory of the method, the gamma field of a point source was calculated under the approximate conditions of use of a gamma-gamma wide-beam method of successive collisions. Based on the calculations and the experimental studies, the dependence of the relative count rate of the weak gamma radiation of a ^{137}Cs point source on mass thickness of the Compton barrier loam for detecting gamma radiation with a 40- by 40-mm NaI(Tl) crystal and gas discharge counters of the STS and VS tube type were studied. The NaI detector gave better results under conditions of discrimination of soft gamma radiation. As a result of the work presented, a column densitometer for continuously measuring the distribution of the density parameters in a core sample from bottom locations was constructed. The precision of the measurements and a mechanical recording of the continuous density diagrams of bottom locations are presented. (INIS)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

23414 (AD/A-009594) EXTENDED SCEPTRE. Volume I. User's Manual. Final Report, 15 May 1972–30 June 1974. Becker, D. (GTE Sylvania, Inc., Needham Heights, Mass. (USA)). Dec 1974. Contract F29601-72-C-0093. 248p. NTIS $7.50.

See also Volume 2, Dec 1974, AD/A-009595.

Volume 1 of Extended SCEPTRE covers circuit preparation and entry and describes the use of the special program options, including: stored model; re-output, continue and rerun; the sub-program capability; and the various print and plot options. Examples of the use of the old and new features are given. Separate chapters contain system information for using SCEPTRE on the 7090/94 and S/360 machines, CDC 6600 system information and additional notes to the user are contained in volume 1, appendixes G and H respectively. (GRA)

23415 (AD/A-009595) EXTENDED SCEPTRE. Volume II. Mathematical Formulation. Final Report, 15 May 1972–30 June 1974. Becker, D. (GTE Sylvania, Inc., Needham Heights, Mass.

(USA)). Dec 1974. Contract F29601-72-C-0093. 111p. NTIS $5.25.

See also Volume 1 dated Dec 1974, AD/A-009594.

Volume 2 of Extended SCEPTRE covers the following subjects pertinent to the dc, ac, and transient solutions: treatment of matrices including sparse matrices, sources and source derivatives, integration routines including implicit integration, and d-c option mathematics and the adjoint network. (GRA)

23416 (TID-26976) ELECTROMAGNETIC PULSE (EMP) PROTECTION ENGINEERING MANUAL. Volume III. Interaction and Coupling. Bevensee, R. M.; Deadrick, F. J.; Landt, J. A.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jan 1976. 130p. Dep. NTIS $5.45.

Data from canonical-problem solutions are presented for estimating EMP effects on generic problems of interest. Data for the loaded straight wire module are presented, and other data modules will be reported in subsequent reports. Representative generic problems to which the straight-wire module may be applied include a dipole antenna in free space, a monopole antenna over perfect ground, a monopole antenna on a structure such as a building or van, a missile in free space, wire antennas of complex geometry, and aircraft-like structures.

Miscellaneous Instruments

Refer also to abstracts 22896, 23342, 23381, 23608, and 24376.

23417 (SAND-74-0083) SANDIA LABORATORIES TECHNICAL CAPABILITIES: INSTRUMENTATION AND DATA SYSTEMS. Lundergain, C. D.; Mead, P. L. (eds.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 22p. Dep. NTIS $4.50.

This report characterizes the instrumentation and data systems capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs.

23418 (SAND-75-0642) DUAL BEAM VIDICON DIGITIZER. Evans, T. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 17p. Dep. NTIS $3.50.

A vidicon waveform digitizer which can simultaneously digitize two independent signals has been developed. Either transient or repetitive waveforms can be digitized with this system. A dual beam oscilloscope is used as the signal input device. The light from the oscilloscope traces is optically coupled to a television camera, where the signals are temporarily stored prior to digitizing. (auth)

23419 ROLE OF CLUSTER SIZE IN A GAS JET TRANSPORT SYSTEM. Wiesehahn, W.; Bischoff, G.; D'Aurai, J. (Simon Fraser Univ., Burnaby, British Columbia (Canada). Dept. of Chemistry). Nucl. Instrum. Methods; 129: No. 1, 187-192(1 Nov 1975).

Six different liquids are utilized in an aerosol generator in conjunction with a gas jet transport system. It appears that the dominant factor influencing efficient transport in such systems is the size distributions of the massive clusters required. Relative yields as a function of gas flow rate as well as X-ray spectra of the products collected are displayed. (NL)

23420 OPERATIONAL AMPLIFIERS FOR FAST NUCLEAR ELECTRONICS APPLICATIONS. Manfredi, P. F.; Maranesi, P. (Politecnico di Milano (Italy). Centro Studi Nucleari E. Fermi). Nucl. Instrum. Methods; 129: No. 1, 283-294(1 Nov 1975).

Two configurations of fast operational amplifiers are considered. They are intended as basic active elements for the implementation of analog circuits in nuclear electronics, for pulse widths shorter than 100 ns. Both operational amplifiers are theoretically analyzed and it is shown how they can be compensated for best operation in different conditions of feedback network and external load. Practical circuits are also given with a discussion about their experimental performances that supply full validity to the theoretical analysis. (NL)

23421 COMMENTS ON "QUARTZ-WINDOW DESIGN FOR GAS-PRESSURIZED PHOTOMULTIPLIER-TUBE INSTALLATIONS" AND AUTHOR'S REPLY. Bargmann, H. W.; Muratori, G. (European Organization for Nuclear Research, Geneva (Switzerland)); Bailey, B. M. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Instrum. Methods; 129: No. 1, 307-310(1 Nov 1975).

The note points out several inconsistencies in a recent paper by Bailey in which he presents results from a finite-element analysis of a spherical shell window for photomultipliers and discusses the correct approach to the problem. The author replies that the inconsistency is due to incorrect graphical representation of some results and argues in defense of the use of finite element analysis for the problem. (NL)

23422 TEMPERATURE-STABLE LINEAR GATE FOR NANOSECOND SIGNALS AND AN OPTIONAL STRETCHER CIRCUIT. Baldwin, A. R.; Madey, R. (Kent State Univ., Ohio (USA). Dept. of Physics). Nucl. Instrum. Methods; 128: No. 3, 557-559(15 Oct 1975).

A temperature-stable linear gate with an optional stretcher circuit has been developed for gating nanosecond signals from photomultipliers. Stabilization of the gate circuit results in a baseline drift at a 50 OMEGA output of less than a millivolt for a 50^0C change in temperature from 0 to 50^0C. In addition to good temperature stability and linearity, this direct-coupled circuit switches in less than 5 ns with small transients; moreover, it is unaffected by the gating or duty cycle. Gate intervals from 30 ns to any larger interval are possible. The response is linear to within 2 percent over 30:1 range of input pulse heights. A linear dynamic range of 300 :1 has been achieved with a combination of two circuits. The optional stretcher circuit integrates the gated pulse from the photomultiplier anode and generates a stretched analog signal which is proportional to the total charge of the gated signal. (NL)

23423 ELIMINATION OF FREQUENCY DEPENDENCE IN GENERATING VOLTMETER. Bagwan, A. B.; Prabhakara, H. R.; Mehta, G. K.; Viswanathan, T. R. (Indian Inst. of Tech., Kanpur). pp 258-262 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Generally high voltages of the order of a few million volts developed in Van de Graaff accelerators are measured using a generating voltmeter. This works on the principle that, when the capacitance between the high voltage dome and a plate [known as stator] near it, is varied, the current induced in the stator circuit is proportional to the dome voltage (V) and the frequency of variation of the capacitance (f); i.e., $i \alpha (fv)$. The current is a measure of V if f is assumed to be constant. Generally f is derived from the main's supply frequency. It is observed that this supply frequency does not remain constant but fluctuates around 50 cycles. Thus the measured induced current fluctuates and introduces some error in the measurement of the voltage even if the actual dome voltage remains constant. To eliminate this, a circuit has been designed which measures the induced charge on the stator instead of current. This induced charge is independent of frequency but is proportional to dome voltage. The voltage so measured is independent of frequency. (auth)

23424 AUTOMATIC DATA LOGGING SYSTEM FOR NUCLEAR COUNTING SYSTEMS. Pansare, A. K.; Patankar, A. V. (Tata Inst. of Fundamental Research, Bombay). pp 302-305 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The paper describes an automatic data logging system suitable for nuclear physics experiments. The system uses integrated circuits for various logic functions and provides a much needed interface between indigenous Hindustan Teleprinter and a counting system. The system converts six digit BCD parallel data from a set of decade counters (ECIL type) to 5-unit CCITT Alphabet No. 2 code of the teleprinter. On receipt of the "print" command, the data is stored and displayed simultaneously. The stored data is multiplexed and encoded to the teleprinter code, which is sequentially scanned converting it serially to operate the electromagnet of the teleprinter. The normal control characters such as "Letter Shift", "Space", etc. are generated by a special character generator on demand. The control logic block controls the full logic operations of the system by giving at appropriate intervals, command signals for the various operations to be sequentially performed. The "print out" takes about 4 seconds. (auth)

23425 PERMANENT-MAGNET DEVICE FOR MEASURING THE FLOW OF SODIUM IN NUCLEAR REACTORS. Dorff, D.; Hans, R. Siemens Rev.; 33: No. 1, 19-22(Jan 1975). (In French).

A permanent-magnet device for measuring the flow of Na in a Na-cooled fast reactor is described. The device is fixed to the outside of the steel pipe carrying the liquid Na and the flow is calculated with the aid of Faraday's law. Measurement of the flow rate is particularly important for detecting blockages due to the formation of oxide deposits. (Metals Abstr.)

23426 DESIGN AND CALIBRATION OF A LOW SPEED WINDTUNNEL FOR STUDYING THE FOLIAR DEPOSITION AND UPTAKE OF AEROSOLS. Craig, D. K.; Klepper, B. L.

(Battelle Pacific Northwest Labs., Richland, WA). Am. Ind. Hyg. Assoc. J.; 36: No. 9, 692-699 (Sep 1975).

A 2.75 m-long (9 ft) windtunnel facility to deliver highly toxic aerosols to the foliage of terrestrial plants under safe and well-characterized conditions is described. Flow velocities of 0.1 to 25 cm/sec in the 930 cm^2 (1 ft^2) cross-section experimental area are attainable. Calibration of this facility using a ^{198}Au-labelled colloidal gold aerosol is presented. (auth)

23427 X-RAY POWDER DIFFRACTOMETER FOR STUDYING RADIOACTIVE MATERIALS. Skaba, V.; Krivy, I. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Cesk. Cas. Fys.; 24: No. 6, 563-567 (Nov 1974). (In Czech)

A description is given of an X-ray diffractometer with a double diffracting arrangement designed for studying the crystallographic characteristics of both radioactive powder and compact samples with a total activity of up to approx. 1 Ci. Special features of the instrument include: (1) x-ray tube rotating around the goniometer axis, (2) Johannson-type monochromator of aluminium, (3) lead shielding between the sample holder and the detector. In addition to geometrical discrimination, the pulse height analysis is also used for eliminating the effect of intrinsic radiation. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

23428 (NP-20757) TWENTY-THIRD ANNUAL REPORT, 1974-75. (Australian Atomic Energy Commission, Coogee). 1975. 135p. Dep. NTIS (US Sales Only) $6.00.

Contents include a review of uranium as a world energy source, Australian uranium, regulatory and safety aspects of nuclear energy, and radioisotopes and uranium. Staff research activities and publications are listed. Accounts are itemized. (AT)

Isotope Separation (Industrial)

23429 (AECL-5118) SUPPLY OF STEAM FROM CANDU REACTORS FOR HEAVY WATER PRODUCTION. Robertson, R.F.S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 16p. (CONF-7409145-1). Dep. NTIS (US Sales Only) $4.50. AECL $0.50.

From IAEA conference on utilization of heat from nuclear reactors for industrial processes and district heating; Pinawa, Manitoba, Canada (2 Sep 1974).

The production of heavy water, which is an established industry in Canada today, is an energy intensive process because very large amounts of water must be heated, cooled and pumped. By 1980, Canada's energy needs for D_2O production will be 420 MW of electrical energy and 3600 MW of thermal energy (as steam). The nature of the process demands that this energy supply be exceptionally stable. Today, production plants are located at or close to nuclear electricity generating sites where advantage can be taken of the low cost of both the electricity and steam produced by nuclear reactors. Reliability of energy supply is achieved by dividing the load between the multiple units which comprise the sites. This report describes the present and proposed means of energy supply to the production sites at the Bruce Heavy Water Plant in Ontario and the La Prade Heavy Water Plant in Quebec. (auth)

23430 ISOTOPE SEPARATION BY PASSIVE Q SWITCHING OF A CO_2 LASER. Dupre, J.; Meyer-Bourbonneux, F.; Meyer, C.; Barchewitz, P. (Paris-6 Univ., 75 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 2, 65-68(21 Jul 1975). (In French)

Theoretical treatment and experimental results of passive Q switching in CO_2 laser allow a new process of isotope separation by laser radiation to be explained. (FR)

23431 THEORETICAL ASPECTS OF THE INCREASE IN CAPACITY OF A GASEOUS DIFFUSION SEPARATION PLANT. Coates, J. H. (CEA, 75-Paris (France)); Guais, J. C.; Lamorlette, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Genie Isotopique). Bull. Inf. Sci. Tech. (Paris); No. 206, 41-48(Sep 1975). (In French)

The rapid expansion of nuclear programs for the future implies a strong growth in the enrichment market and the need to plan capacity increases to meet the new requirements. This article deals more specifically with increased output from an existing plant, of which the characteristics were optimized earlier on the basis of a production goal and of the economic conditions at the time. The solution in such a case is either to modify the equipment already installed in the plant or to install extra equipment, optimizing its internal parameters as a function of the amount of separation work required and of its lay-out in the original plant or in a new plant. (FR)

23432 CHECKING OF GASEOUS DIFFUSION BARRIERS BY THE ARGON SEPARATION METHOD. Lejeune, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Genie Isotopique). Bull. Inf. Sci. Tech. (Paris); No. 206, 21-29(Sep 1975). (In French)

Study and characterization of gaseous diffusion barriers is obtained through the determination of several parameters representative of the quality of the samples: permeability, porosity, mean pore radius, pore distribution, specific area... Among the points which have to be known with accuracy, the separation efficiency S and the aerodynamic efficiency Z can be obtained by enrichment measurements made on argon isotopes. After a short definition of these factors of efficiency which characterize the functioning of a barrier in given conditions, the principle of the method of separation used for their experimental determination on benches working with argon is presented. A detailed description of the equipment, and a complete analysis of the mode of exploitation of the measurements are given. (FR)

23433 THE CHOICE OF INTERNAL CHARACTERISTICS OF A GASEOUS DIFFUSION PLANT. Theoretical Aspects: Decomposition and Multi-level Optimization. Guais, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Genie Isotopique). Bull. Inf. Sci. Tech. (Paris); No. 206, 31-40(Sep 1975). (In French)

The optimum choice of all the internal characteristics of a gaseous diffusion plant for minimizing the enrichment cost, is a large scale problem. The mathematical analysis of the model simulating such a plant has led to the observation of a hierarchical structure, introducing a method of decomposition. The multi-level approach focuses successively on three levels: the stage, the cascade, the plant. Then each level can be solved specifically, using an algorithm properly suited to its characteristics. The problem is to coordinate properly the sub-optimizations by using coordination variables. This method has effectively been used for years as a tool for the decision-makers, in association with the experimental and development work, and the industrial analysis, furnishing the current technical and economical data at the moment of the decision: plant capacity, component performances, economical prices and trends. (FR)

23434 FRENCH PROGRAM FOR URANIUM ISOTOPIC ENRICHMENT BY GASEOUS DIFFUSION. Bernaud, C. (CEA Direction des Productions, 92-Chatillon (France)); Besse, G. (Societe EURODIF, 92-Bagneux (France)); Coates, J. H. (CEA, 75-Paris (France)); Frejacques, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. de Chimie); Sartorius, R. (Societe de Fabrication d'Elements Catalytiques (SFEC), 84-Bollene (France)). Bull. Inf. Sci. Tech. (Paris); No. 206, 5-7(Sep 1975). (In French)

The French program on uranium enrichment by gaseous diffusion is briefly reviewed. Research and development activities, enrichment plant projects, and industrial support are described. (FR)

23435 PROCESS AND APPARATUS FOR THE SEPARATION OF TWO ISOTOPES. Levy, R. H.; Janes, G. S. (to Jersey Nuclear Avco Isotopes, Inc., Bellevue, Wash. (USA)). Swiss Patent 534,538/D/. 30 Apr 1973. 7p. (In French)

A procedure for the separation of two isotopes is described in which a vapor composed of atoms is produced. The vapor is exposed to a primary radiation emitted by a primary source at a frequency which excites the atoms of the first isotope but not the atoms of the second isotope. The vapor is then exposed to a secondary radiation emitted by a source at a frequency which ionizes the excited atoms of the first isotope but not the excited atoms of the second isotope. The ionized atoms are separated from the non-ionized atoms. The apparatus consists of a closed container connected to a vacuum pump. It has an opening centered on an optical axis for the admission of the radiation to the interior of the container. Evaporators are arranged in the container which produce an atomic beam perpendicular to and crossing the optical axis. The beam has a greater dimension in the direction parallel to the optical axis than in the direction perpendicular to it. A primary collection plate is placed in the container to receive the atomic beam and there is a second collection plate placed at the side of the atomic beam. The apparatus also includes the primary and secondary radiation sources. (tr-INIS)

23436 ISOTOPE EXTRACTION BY DISTILLATION. Baertschi, P. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 440-443(Nov 1974). (In German)

The basic equation is given for enrichment factors in co-existing systems, and tabulated data given for systems based on H_2, CO, NC, H_2O, BF_3, CCl_4, and $(CH_3)_2CO$, for working temperatures, isotope system, and extraction parameters. Isotope extraction by water distillation is discussed and heavy water concentration using DMSO. A data table is included for enrichment plant for H_2 ^{18}O and H_2 ^{17}O with dimensions of equipment with flowrates of 120, 37, 6 and 1.6 cm^3 per minute. (INIS)

23437 ENRICHMENT OF BORON, CARBON, AND SILICON ISOTOPES BY MULTIPLE-PHOTON ABSORPTION OF 10.6-μm LASER RADIATION. Lyman, J.L.; Rockwood, S.D. (Los Alamos Scientific Laboratory, University of California, P. O. Box 1663, Los Alamos, New Mexico 87545). J. Appl. Phys. 47: No. 2, 595-601 (Feb 1976).

The polyatomic molecules SF_6, BCl_3, CF_2Cl_2, and SiF_4 have been irradiated in the presence of H_2 or N_2 using intense focused CO_2 laser pulses. All four of the polyatomic molecules underwent isotopically

selective reactions showing depletion of the isotopic forms irradiated. The best enrichment was achieved with SF_6; however, all systems showed similar behavior with regard to pressure and irradiation time. Both BCl_3 and SiF_4 showed evidence of isotopic rescrambling reactions that occurred on about a 1-h time scale. The mechanisms of the absorption process are believed to be enabled by the large density of states in the vibrational manifold of polyatomic molecules. (auth)

23438 ISOTOPE SEPARATION IN A SUPERSONIC STREAM. Basov, N.G.; Belenov, E.M.; Gromov, V.V.; Isakov, V.A.; Leonov, Yu.S.; Markin, E.P.; Oraevskii, A.N.; Romanenko, V.I.; Ferpontov, N.B.; Shapovalov, D.S. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 22: No. 3, 71-72 (5 Aug 1975).

Nitrogen isotopes were separated by ultrasonic expansion of a hot mixture of the reagents through a nozzle. The results uncover a possibility of separating the isotopes of reagents with high freezing temperature. (auth)

Isotopic Power Sources

23439 (DPST-74-128-2) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Feb 1974. Contract AT(07-2)-1. 42p. Dep. NTIS $4.00.

SNS has requested a review of specifications for $^{238}PuO_2$ feed. A full-scale demonstration with an optimized ball mill produced the required particle size distribution in 2 h compared to 32 h for previous designs. Six pellets have been hot-pressed to show reproducibility of hot-press conditions. Lower densities than expected were obtained for pellets fabricated according to the recommended parameters. 440 g of direct-strike $^{238}PuO_2$ were produced for the Milliwatt RTG program; the oxide contains considerably more fines than expected. (auth)

23440 (DPST-74-128-3) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Mar 1974. Contract AT(07-2)-1. 53p. Dep. NTIS $4.50.

Specifications proposed by SRP for $^{238}PuO_2$ feed are presented in response to an SNS proposal for tighter specifications. Calculations show that radiolysis of volatiles in $^{238}PuO_2$ storage and shipping containers will not result in excessive pressure within the vessel nor potential damage from hydrogen reaction. The design of the $^{16}O_2$ exchange furnace can employ $^{16}O_2$ flowing over beds of $^{238}PuO_2$, rather than through the powder, without significant loss of efficiency or time. BET surface area analysis of $^{238}PuO_2$ powders yields only approximate values because of self-heating of the powder. PPO and PMC shards were not damaged from released helium after 2 months aging. Post-hot-pressing heat treatment of PPO pellets has begun to optimize and shorten the time required to remove carbon, complete sintering, and restore stoichiometry. A surface-barrier detector is being adapted to measure residual alpha activity on PISA's after decontamination in the PuFF Facility. Because of high fines content in a recent production of direct-strike $^{238}PuO_2$ an older lot was shipped to MRC for the Milliwatt RTG. This lot subsequently was shown also to have a large amount of fines caused by long-term aging. Both direct-strike and reverse-strike oxide were found to exhibit this degradation. The contaminated glove box and obsolete metallograph in the Alpha Materials Facility have been removed and the replacement glove box with the new metallograph mounted in place. (auth)

23441 (DPST-74-128-4) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Apr 1974. Contract AT(07-2)-1. 32p. Dep. NTIS $4.00.

In direct-strike $^{238}PuO_2$, agglomeration occurs in the oxalate precipitate and is unaffected by washing agent or calcining temperature. The evaluation of an automatic pulverizer-classifier for the PuFF Facility was begun. Difference between the mini-hot press at SRL and the LASL full-scale hot press require higher pressures to be used at SRL to obtain the density specified for PPO. Hot-pressed density was found to vary with applied pressure and, to a lesser extent, with size of feed. The new contained metallograph has been installed. A wire saw has been placed in containment for precise cutting of PPO pellets. The scanning microscope was mounted within the glove boxes. (auth)

23442 (LA-6082) PERFORMANCE OF MULTIHUNDRED-WATT FUELED-SPHERE ASSEMBLIES IN THE SAFETY VERIFICATION TEST. Cramer, E. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-eng-36. 25p. Dep. NTIS $5.00.

Seven fueled-sphere assemblies equivalent to those proposed for use in multihundred-watt thermoelectric generators were subjected to conditions that simulated the sequential environments produced by an orbital abort and earth impact. The procedures were similar to those in the Safety Sequential Test, and the assemblies differed only in minor dimensional and power level changes. All assemblies met the specifications for flight quality units. Visual examination indicated that all the iridium shells had lost their containment capability; however, rupturing of two shells was not confirmed. Five were obviously ruptured, and the fuel in three was exposed. All iridium fractures were essentially intergranular. A large grain size may have promoted this type of failure. Half of the vent assemblies failed to pass helium at ambient temperature after the test. Failure was because of nonmetallic materials in the vent frits. Release of plutonia per unit area of cracks in a containment shell ruptured by simulated earth impact was determined.

23443 (MLM-2203) WARM HYDROFORMING OF IRIDIUM + 0.3 WT PERCENT TUNGSTEN HEMISHELLS. Wyder, W. C. (Mound Lab., Miamisburg, Ohio (USA)). 5 Mar 1976. Contract E-33-1-GEN-53. 14p. Dep. NTIS $4.00.

A technique for the production of iridium alloy hemispherical shells to be used for the primary encapsulation of plutonium-238 oxide spheres is described. The encapsulated spheres, 24 per heat source, provide the thermal heat used to drive thermoelectric converters which supply power for the Department of Defense's LES 8/9 satellites. The technique used a standard production type Hydroform machine converted for hot tooling. The iridium alloy discs were canned in stainless steel waster sheets of a larger size than the iridium discs and separated from the latter by tantalum foil barrier discs. The stainless steel was electron beam welded around the edge to form an envelope. The iridium disc assembly was heated to approximately 900°C and the tooling to approximately 500°C. After forming, the iridium shell was cut to length while in the waster sheet; and the latter was removed by dissolving in hot aqua regia. After removal of the waster sheets, the hemishells were cleaned and heat treated. Production efficiency reached a level of better than 95 percent and was maintained to produce some 600-odd hemishells.

Radiation Sources

Refer also to abstracts 22867 and 22990.

23444 (MLM-2291) ULTRASONIC EXAMINATION OF THIN IRIDIUM HEMISPHERES FOR THE MULTIHUNDRED WATT HEAT SOURCE. Dudley, W. A. (Mound Lab., Miamisburg, Ohio (USA)). 30 Dec 1975. Contract E-33-1-GEN-53. 14p. Dep. NTIS $4.00.

An ultrasonic method was developed for nondestructive inspection of the structural integrity of the 20-mil (0.0508-cm) thick iridium hemispheres that are used in the fabrication of Multihundred Watt (MHW) radioisotopic heat sources. A hemisphere was considered unacceptable if a back-surface ultrasonic response change was equivalent to that obtained from a 0.010-in. (0.0254-cm) diameter flat-bottomed hole in the standard. Flaws were detected in hemispheres made by the initial fabrication process. Typical flaws found ultrasonically in these units and revealed by metallography are shown. Hemispheres formed after a change to a different fabrication process were free of flaws. (auth)

23445 LEAK TESTS OF SEALED SOURCES CONTAINING RADIUM. Terrani, M.; Terrani, S. (Politecnico di Milano (Italy). Centro Studi Nucleari E. Fermi). Energ. Nucl. (Milan); 21: No. 5, 282-286(1974). (In Italian)

A simple method for leak-testing sealed sources containing radium is described. The radon leaking from sources is collected in a vial and its activity is determined by a current ionization chamber or by a GeLi detector. The two counting techniques are described and compared. The limits of leak detection obtained are of the order of 100 atoms/s. (INIS)

23446 THE ENERGY SPECTRUM OF A LOW SPECIFIC ACTIVITY KILOCURIE ^{60}Co SOURCE FOR AGRICULTURAL RESEARCH. Visser, C. J.; Searle, M. A. (Fruit and Food Technology Research Inst., Stellenbosch (South Africa)). Agrochemophysica; 6: 43-48(1974).

With summary in Afrikaans and French.

Conventional detectors cannot be used to measure the energy spectrum of a high intensity source directly. Such a source was simulated by using a low intensity (~10 μCi) source to permit a laboratory determination of the spectrum, using gamma spectrometric techniques. The results show that although energy degradation in large sources of low specific activity is considerable, they have advantages above high specific activity sources.

Design and Fabrication

Refer also to abstract 23510.

Industrial Uses

23447 (IEA-388) TRANSITION TIME FOR WATER OF THE JUQUERI RIVER ALONG THE EAST BRANCH TO THE PIRAPORA RESERVOIR. Plata Bedmar, A.; Garcia Agudo, E.; Martins de Albuquerque, A.; Sanchez, W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1975. 19p. (In Portuguese). Dep. NTIS (US Sales Only) $3.50.

The time of travel of the Juqueri River water through the east branch of the Pirapora Reservoir was measured using radioactive tracers (^{131}I) (6 Ci in KI solution). The changes in Juqueri River flow rate were also measured during the run. The center of mass of the radioactive iodine was used for the time of travel calculations. Six measurements of the Juqueri River flow rate were performed on different days, using the total count method. Fifty millicuries of ^{131}I were used in each run. The results of time of travel obtained under non-steady conditions and their correction for steady state are also discussed. (auth)

23448 (IEA-389) WATER PERCOLATION CONDITIONS AT THE ENTRANCE OF THE CANAL LOCKS OF THE PARANA RIVER USING RADIOISOTOPIC TECHNIQUES. Sanchez, W.; Guidicini, G.; da Silva, R. F. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1975. 21p. (In Portuguese). Dep. NTIS (US Sales Only) $3.50.

Radioisotopic techniques used in the study of water percolation at the construction site of the canal lock of the Ilha Solteira Dam are discussed. At the time of the drilling operations, using rotative drills, which were necessary to complement the surface geological studies, a water loss was discovered in the vicinity of basalt lava flows. The water leakage tests showed that the total absorption of pumping flow was about 80 liters per minute. To determine the velocity of water percolation in the probable cracks or fractures of the basalt, a test using a radioactive tracer (^{131}I) was used. Previous tentative tests, using dyes, proved to be unsatisfactory. For the study of the radioactive tracer behavior two techniques were tried: (a) measurement of its dilution in the original water of the well; and (b) measurement of residence time. Results from the tests showed the existence of a crack or a set of cracks oriented from the radioisotopic injection well to the artesian wells located at the left shore of Parana river, below Ilha Solteira Dam. The cracks were localized near the contact between the basalt lava flows.

23449 THE DOSE DISTRIBUTION WITHIN THE COBALT-60 IRRADIATION UNIT OF THE FRUIT AND FRUIT TECHNOLOGY RESEARCH INSTITUTE, STELLENBOSCH. Visser, C. J.; Haasbroek, F. J.; de Villiers, J. F. (Fruit and Food Technology Research Inst., Stellenbosch (South Africa)). Agrochemophysica; 6: 67-72(1974).

The exposure and absorbed dose distribution in a concrete irradiation unit, fitted with a 5200 Ci ^{60}Co source of relative low specific activity, is described. The dose distribution is compared with that obtained with a former 488 Ci source. Measurements with an ionization chamber, as well as solar cell and chemical dosimeters are discussed. A rapid method for the calculation of the dose at a given point in the irradiation area using a universal equation for the dose distribution is facilitated by a programmable desk calculator. (INIS)

23450 "POOL" LABORATORY IRRADIATION FACILITY. Herrnhut, H.; Latzer, B. (Sulzer Bros. Ltd., Winterthur (Switzerland)). Sulzer Tech. Rev.; Research No. p. 3-5: (1974).

Ionizing radiation is exploited in a variety of areas, such as medicine, biology, chemistry etc. New processes must be tested before application, to ensure that the methods will be successful in use. Two examples are the hygienization and sterilization processes, which are already being used industrially. The "Pool" γ irradiation unit has been developed to provide research with a testing facility of this kind. It is a laboratory unit with a particularly flexible source configuration. With this plant, it is possible to irradiate spaces, enabling the use of γ irradiation in the various fields of research to be subjected to critical appraisal. (auth)

23451 STUDY OF REACTIONS OF OXYGEN AND HYDROGEN PEROXIDE BY MEANS OF O^{18}. V. Mechanism of Electrochemical Reduction and Oxidation of Hydrogen Peroxide on Pyrographite. Tarasevich, M. R.; Zakharkin, G. I. (AN SSSR, Moscow. Inst. Ehlektrokhimii). Elektrokhimiya; 10: No. 12, 1818-1823(Dec 1974). (In Russian)

For English translation see the journal Sov. Electrochem.

Electrochemical reactions of hydrogen peroxide on pyrographite were studied. Measurements made over a wide range of pH (0.3 to 14.2) and of hydrogen peroxide concentrations (10^{-3} to 1 N) established the mechanism of electrooxidation and electroreduction of hydrogen peroxide and indicated a general scheme of this process. It was shown that, depending on the peroxide concentration, H_2O_2 or HO_2^- units are weakly (low concentration) or strongly (high concentration) adsorbed by reacting units. In all cases, the delayed stage is the joining (recoil) of the first electron. (INIS)

23452 METHODS FOR DETERMINATION OF BULLET PENETRATION DEPTH IN PERFORATING. Akchurin, M. M.; Pudikov, V. V. Neftegazov. Geol. Geofiz.; No. 6, 36-40(1974). (In Russian)

3 refs.

A method for determining the depth of penetration of a projectile into a stratum with a perforator using radioactive radiation is presented. The method is used in distinguishing the surrounding petroleum-bearing layers using radioactive indicators for determining the depth of penetration of the indicators into the layer and determining the penetrating capability of the projectile of a perforator under borehole conditions. (tr-auth)

23453 SHIFTING SANDS. Bain, C. A. R. (Southern Universities Nuclear Inst., Faure (South Africa)). Nucl. Act.; No. 12, 6-10(Jan 1975).

Modern day harbour design and construction and the preservation of beaches require accurate knowledge of silt and sand movement. The radioisotope tracer techniques have become an accepted part of the investigations which precede harbour engineering activity. (INIS)

23454 DIFFUSION IN AN IDEALISED COUNTERCURRENT GAS CENTRIFUGE. Dardel, E. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). Z. Angew. Math. Phys.; 25: No. 6, 829-842(25 Nov 1974). (In German)

A separation theory is presented in the case of a plane two-dimensional model of an idealised countercurrent gas centrifuge. The enrichment and the separative power are compared with those obtained by the method of Martin, Kuhn and Cohen. (auth)

LIFE SCIENCES

23455 (UCD-472-122, pp 165-167) SOME SPECULATIONS ON THE ROLE OF RADIATION QUALITY ON "INJURY" AND TUMOR RISK FROM BONE-SEEKING RADIONUCLIDES. Goldman, M.; Rosenblatt, L. S. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Relative effectiveness of three bone-seeking radionuclides in beagles following intravenous injection are quantified in terms of initial (less than 1 year) marrow "injury" (neutropenia) and late effects (osteosarcoma incidence). The non-linear dose-response curves for both end points were fit to a probit model and at lower doses, producing the same degree of initial neutropenia, relative tumor incidences for ^{90}Sr, ^{226}Ra, and ^{239}Pu were 1, 10, and 100, respectively. (auth)

Radiation Effects on Biochemicals

23456 (NIRS-14, pp 13-46) BIOLOGICAL STUDIES. Sep 1975.

In annual report, 1974.

Abstracts are presented of research in the biological sciences. The projects include studies in the following areas: biochemistry; biophysics; cytology; morphology; physiology; and genetics. (ERB)

23457 EFFECTS OF GLUCOSE IRRADIATED BY HIGH DOSES OF ^{60}COBALT γ RAYS, AND OF SOME PRODUCTS OF GLUCOSE RADIOLYSIS ON THE GROWTH OF JERUSALEM ARTICHOKE TISSUE AND POTATO SHOOTS CULTURE IN VITRO. Manant, P. (Paris-6 Univ., 75 (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 1, 71-74(7 Jul 1975).

Glucose, irradiated in dry conditions by γ rays from 5.10^5 to 10^7 rad, and incorporated into culture medium, inhibits growth and, simultaneously, increases rhizogenesis of Jerusalem Artichoke tissue in culture. Tuberisation of potato shoots grown in vitro is delayed and partially inhibited. Some substances which result from radiolysis of sugars give the same results, but only at higher concentrations. (FR)

23458 PREPARATION OF 4'-AZIDO-2'-NITRO-L-PHENYLALANINE AS LABEL FOR AMINO ACID TRANSPORT SYSTEMS IN BIOLOGICAL MEMBRANES. Fahrenholz, F. (Max-Planck-Institut fuer Biophysik, Frankfurt am Main); Schimmack, G. Z. Physiol. Chem.; 356: No. 4, 469-471(Apr 1975). (In German).

The synthesis of 4'-azido-2'-nitro-L-phenylalanine is described. It could be activated by irradiation ($\lambda > 345$ nm) within a few minutes and can thus possibly be used for labeling amino acid transport systems in biological membranes. (auth)

Radiation Effects on Cells

23459 (LA-tr-74-3) CELL CYCLE ANALYSES WITH A PULSE CYTOPHOTOMETER: THE EFFECT OF CHEMICAL AND PHYSICAL NOXAE ON THE KINETICS OF THE PROLIFERATION OF TUMOR CELLS. Goehde, W. (Muenster Univ. (F.R. Germany). Inst. fuer Strahlenbiologie). 1974. Translation of German Report. 122p. Dep. NTIS $5.50.

Thesis.

The following studies were conducted on Ehrlich ascites tumor cells using the pulse cytophotometer: rate of DNA synthesis during the S phase; the effect of cytostatic drugs, endoxan, bleomycin, and other antibiotics on cell kinetics; and effects of x radiation and 1 to 6 MeV neutrons on cell kinetics. (HLW)

Radiation Effects on Microorganisms

Refer also to abstract 23456.

23460 (SAND-75-0168) INACTIVATION OF BACTERIA IN SEWAGE SLUDGE BY IONIZING RADIATION, HEAT, AND THERMORADIATION. Brandon, J. R.; Langley, S. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 43p. Dep. NTIS $5.00.

For purposes of animal feeding or fertilizer usage on edible crops, sewage sludge must be free of pathogenic organisms. Bacterial inactivation by a combination of heat and irradiation is shown to be effective. These results must be viewed in conjunction with those from studies of parasite egg inactivation, virus inactivation, and physical-chemical benefits in order to make a fair assessment of the value of the thermoradiation treatment compared to other possible sludge treatment processes. (auth)

23461 ULTRAVIOLET AND TEMPERATURE SENSITIVITY OF P_{22} PHAGE MUTANTS. Avramova, R. (Letopisi Khig.-Epidemiol. Sluzhba; 8: No. 44, 183-187(1974). (In Russian).

The moderate phage P_{22} and its virulent mutants No. 1, No. 2, and No. 3 derived with the aid of 5-bromuracyl were used. S. typhimurium LT-2 strain served as indicator culture. The number of viable phage particles after thermal and uv treatment was determined by the agar layer technique. In uv irradiated bacteriophages only the lethal effect of uv rays was recorded. It was shown that the curve reflecting the number of phage particles surviving uv treatment, depending on the duration of exposure, is an exponential one, i.e., it is expressed with a straight incline. Minor differences in the degree of inactivation of phage P_{22} and its mutants have been observed, most likely due to genetic or phenotype heterogenicity of the phage populations. In testing the thermal inactivation by consecutive freezing and thawing of phage suspensions it was shown that it was not until after fivefold freezing and thawing that a decrease of approximately one order was attained in the titers of the moderate phage P_{22} and its virulent mutants. The results of the assay of the inactivating effect of high temperature on phage P_{22} and its mutants are nearly the same as the ones obtained from testing their uv sensitivity. (Abstr. Bulg Sci Med Lit)

23462 ROLE FOR DEOXYRIBONUCLEIC ACID LIGASE IN DEOXYRIBONUCLEIC ACID POLYMERASE I-DEPENDENT REPAIR SYNTHESIS IN TOLUENE-TREATED ESCHERICHIA COLI. Billen, D.; Hellermann, G. R.; Stallions, D. R. (Oak Ridge National Lab., TN). J. Bacteriol.; 124: No. 1, 585-588(Oct 1975).

In a toluene-treated mutant of Escherichia coli K-12 having a temperature-sensitive, conditionally lethal mutation in the structural gene for deoxyribonucleic acid (DNA) ligase, an extensive DNA repair synthesis occurred in x-irradiated cells at the nonpermissive temperature, 42°C. At the permissive temperature, 30°C, nearly normal semiconservative synthesis and limited repair synthesis were observed when DNA ligase was activated by the addition of nicotinamide adenine dinucleotide. (auth)

23463 USE OF ULTRAVIOLET RADIATION AND NITRIC ACID IN THE SELECTION OF L-ISOLEUCINE PRODUCERS. Kaleya, E.; Linde, E. (Inst. of Microbiology, Riga). Latv. PSR Zinat. Akad. Vestis; No. 11, 49-52(1975). (In Russian).

Sarcina IV-67 was used as a source strain in the present study. 213 auxotropic mutants were selected after their treatment with HNO_2, uv-rays and after affecting them with mutagens. Two most active mutants capable of 1-isoleucine biosynthesis ranging from 1 to 2.5 g/l were selected for further study. Nutrient requirements were determined. Mutant No. 23-22 was observed to require cysteine, proline and calcium pantotheonate. Another mutant No. 22-6 required group B vitamins, a variety of amino acids, purine and pyridine bases, as well as γ-amino-butyric acid. (auth)

23464 ENZYMATIC INDUCTION OF DNA DOUBLE-STRAND BREAKS IN gamma-IRRADIATED ESCHERICHIA COLI K-12. Bonura, T.; Smith, K. C.; Kaplan, H. S. (Stanford Univ., CA). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 11, 4265-4269(Nov 1975).

The polA1 mutation increases the sensitivity of E. coli K-12 to killing by gamma-irradiation in air by a factor of 2.9 and increases the yield of DNA double-strand breaks by a factor of 2.5. These additional DNA double-strand breaks appear to be due to the action of nucleases in the polA1 strain rather than to the rejoining of radiation-induced double-strand breaks in the pol$^+$ strain. This conclusion is based upon the observation that gamma-irradiation at 3° did not affect the yield of DNA double-strand breaks in the pol$^+$ strain, but decreased the yield in the polA1 strain by a factor of 2.2. Irradiation of the polA1 strain at 3° followed by incubation at 3° for 20 min before plating resulted in approximately a 1.5-fold increase in the D_0. The yield of DNA double-strand breaks was reduced by a factor of 1.5. The pol$^+$ strain, however, did not show the protective effect of the low temperature incubation upon either survival or DNA double-strand breakage. We suggest that the increased yield of DNA double-strand breaks in the polA1 strain may be the result of the unsuccessful excision repair of ionizing radiation-induced DNA base damage. (auth)

Radiation Effects on Plants

Refer also to abstract 23457.

23465 COMBINED EFFECT OF VIBRATION AND IONIZING RADIATION ON THE GROWTH PROCESSES OF MODEL PLANTS. Communication I. Miller, A.; Steine, B. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis; No. 11, 16-21(1975). (In Russian).

Germinating lettuce seeds and isolated tomato roots were treated with different combinations of ionizing radiation and vibrations of medium frequency. It was found that in intensively growing roots subjected to the vibration prior to radiation the negative effect of ionizing radiation decreases. Application of vibration after the radiation intensifies radioactive effect. (auth)

23466 COMPETITION ABILITY OF VARIETIES AND NATURAL SELECTION IN IRRADIATED SYNTHETIC POPULATION OF OAT. Dislers, V.; Konrads, N.; Rasals, I. (Inst. of Biology, Riga). Latv. PSR Zinat. Akad. Vestis; No. 11, 34-39(1975). (In Russian).

The population of oat, composed of a mixture of four varieties and irradiated with gamma rays, the dose being 12 kR, was grown to the M_3 generation on the plots of competition trials. It was shown that the radioresistance of varieties did not correlate with the competition ability. The effect of directional natural selection in the irradiated population was not observed. The absence of variability of traits like plant height and number of spikelets on plant in M_3 was displayed. The selection of plants according to quantitative traits in the first 2 to 3 generations after irradiation, and hitherto the elimination of induced mutations as a result of stabilizing natural selection, is recommended. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 22833 and 22843.

23467 (AED-CONF-75-141-019) FUNDAMENTALS OF NEUTRON THERAPY. Lorenz, W. J. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Nuklearmedizin). 1975. 21p. (In German). INIS.

From 6th scientific meeting of the Deutsche Gesellschaft fuer Medizinische Physik; Berlin, F. R. Germany (28 Apr 1975).

9 figs.; 4 tabs.; 19 refs. Available from ZAED.

A survey is given on the physical dosimetrical, and radiation biological fundamentals of fast neutron therapy and neutron capture therapy, and possible medical indications for neutron capture therapy are presented. (DE)

23468 (AED-CONF-75-244-002) THE RISK OF RADIATION HAZARDS IN THE DIAGNOSTIC APPLICATION OF RADIOACTIVE MATERIALS. Kaul, A.; Roedler, H. D. 1975. 20p. (In German). INIS.

From 16th annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte; Kiel, F. R. Germany (20 Jun 1975).

3 figs.; 6 tabs.; 14 refs. With abstract. Available from ZAED.

For the most important of the manifold methods and radionuclides used in nuclear medicine diagnostics, limiting energy dose values are given, and the mean genetic and somatic exposure to radiation of the general population is determined in consideration of the frequency of administrations with the aid of population statistics. An attempt was made to assess the somatic and genetic risks connected with different diagnostic methods from their degree of radiation exposure as so-called calculated maximum risks, and to discuss them in relation to the maximum acceptable risk. (DE)

23469 (ARH-SA-242) EMERGENCY PREPAREDNESS: A COMPREHENSIVE PLAN. Wilson, R. H. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1 Jul 1975. 10p. (CONF-750707-8). Dep. NTIS $3.50.

From annual meeting of the Health Physics Society; Buffalo, New York, USA (12 Jul 1975).

The Atlantic Richfield Hanford Company (ARHCO) has developed comprehensive plans for coping with emergencies ranging from criticality to civil disturbance. A unique notification system provides for immediate contact with key personnel by using a central communications center, crash alarm warning networks, and a continuing telephone cascade notification system. There is also the capability of immediately contacting other contractor key personnel. Certain jobs have been predetermined as necessary for coping with an emergency. An emergency staff consisting of responsible management, with alternates, has been preselected to automatically fill these jobs when notified. Control centers for headquarters and "field" are established with telephone and radio communication capabilities and are also supplied with some source materials to assist initiating plans for containing an emergency for recovery. A comprehensive emergency procedures manual has been developed, which contains information of company-wide application and procedures for specific facilities covering almost all accident situations. (auth)

23470 (CEA-CONF-3113) DOSIMETRIC IMPLICATIONS OF THE EXPOSURE TO THE NATURAL SOURCES OF IRRADIATION. Beninson, D. J.; Bouville, A.; O'Brien, B. J.; Snihs, J. O. (United Nations Scientific Committee on the Effects of Atomic Radiation). 1975. 54p. (CONF-750671-3). Dep. NTIS (US Sales Only) $4.50.

From international symposium on areas of high natural radioactivity; Pocos de Caldas, Brazil (16 Jun 1975).

Natural radiation is of two origins, extraterrestrial and terrestrial. Extraterrestrial radiation originates in outer space as primary cosmic rays and reaches the atmosphere, with which the incoming energy and particules interact, giving rise to secondary cosmic rays to which living beings on the earth's surface are exposed. Terrestrial radiation is emitted from radioactive nuclides present in varying amounts in all soils and rocks, the atmosphere and the hydrosphere, and from those radionuclides that, transferred to man through food chains or by inhalation, are deposited in his tissues. Terrestrial radioactivity, therefore, leads to both external and internal exposure. Data are summarized as the radiation dose and dose rate to human populations from natural radiation. (CH)

23471 (CEA-CONF-3122) CONTRIBUTION TO THE SOLUTION OF THE PROBLEMS RAISED BY THE APPLICATION OF THE PRINCIPLE OF PROTECTION OPTIMIZATION TO NUCLEAR PLANTS. Lacourly, G.; Demerle, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 6p. (CONF-750518-5). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

The radiological protection of populations and the environment rests on two main principles: the dose delivered to the individuals of the most exposed population group must remain below the dose limits set up by regulations; and the doses must be kept as low as readily achievable, social and economic considerations being taken into account. Estimations of cost of radiation protection at different levels are presented. (CH)

23472 (CONF-740930-, pp 120-124) CYTOGENETIC DETERMINATION OF THE EFFECT OF IRRADIATION ON IN VITRO LYMPHOCYTE TRANSFORMATION RATES. Lloyd, D. C.; Dolphin, G. W.; Purrott, R. J. (National Radiological Protection Board, Harwell, Eng.). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The effect of x irradiation on the yield of transformed cells in 48-hr cultures has been studied in human peripheral-blood lymphocytes. Cytogenetic damage was used as a marker, aberration yields being obtained for mixed cultures prepared from equal numbers of normal and irradiated lymphocytes and from pure cultures of irradiated cells. Comparison of data from these two types of culture shows that the yield observed ranged from 90 percent of that expected at 50 rads to 11 percent at 700 rads. Poisson analysis demonstrated that for all doses, cells with high levels of structural damage were not selectively eliminated. The extent to which mitotic delay contributes to the reduction in numbers of transformed cells was examined by varying the time in culture from 36 to 72 hr. The implication of this work in the field of radiation-dose estimation by chromosome-aberration analysis is discussed. (auth)

23473 (CONF-740930-, pp 125-139) SURVIVAL OF HUMAN LYMPHOCYTES AFTER EXPOSURE TO DENSELY IONIZING RADIATIONS. Madhvanath, U.; Raju, M. R.; Kelly, L. S. (Univ. of California, Berkeley). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Interphase death of human blood lymphocytes cultured in vitro was studied after exposure to ^{60}Co gamma rays and to accelerated ions of ^{1}H, ^{4}He, ^{7}Li, ^{11}B, ^{12}C, ^{20}Ne, ^{40}Ar, and π^- meson beam under aerobic conditions. Exposures were also conducted under hypoxic conditions with ^{60}Co gamma rays, ^{4}He, ^{7}Li, and ^{12}C ion beams. Time course of interphase death was followed for 6 days after irradiation. Percent survivals were determined by using the trypan blue exclusion method. Survival curves at 5 days postirradiation were exponential for all radiations studied. These observations indicate that the production of interphase death of lymphocytes by

densely ionizing radiations follows a pattern similar to that observed with colony-forming mammalian cells. However, the reproductive capacity of the latter cells is impaired with maximum effectiveness at energy densities associated with 220 keV/mu m for the beam conditions used in this investigation. The much lower energy densities required to kill a lymphocyte suggest that a sensitive structure other than DNA may be responsible for the production of lymphocyte death, perhaps the membranes. The calculated inactivation cross sections for high-LET radiations above 650 keV/mu m yielded values larger than the actual cell dimensions. It appears that contributions from delta rays become appreciable in this system at these LET's. (auth)

23474 (CONF-740930-, pp 140-143) EFFECT OF POSTIRRADIATION ANOXIA ON RADIOSENSITIVITY OF LYMPHOCYTES. Schrek, R. (Veterans Administration Hospital, Hines, IL). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Radiosensitivity was measured by viable-lymphocyte counts and by uridine uptake. The viability of the lymphocytes was based on morphologic characteristics visualized by phase contrast microscopy of the cells in a special slide chamber. Low doses of X rays (10 to 1000 R) and incubation at 37°C killed lymphocytes in interphase with the production of pyknotic nuclei (nuclear death), and large doses (6000 R) produced nuclei with clear nucleoplasm (cytoplasmic death). Nuclear, but not cytoplasmic, death was inhibited by incubation of the irradiated cells at 27°C. Postirradiation anoxia had no effect on development of the nuclear and cytoplasmic death of lymphocytes irradiated with 100 to 6000 R. Anoxia had no effect on the early response of lymphocytes to phytohemagglutinin (PHA) [increase in ribonucleic acid (RNA) and protein synthesis] but inhibited completely the late effects [increase in deoxyribonucleic acid (DNA) synthesis and transformation into lymphoblastoid cells]. The PHA caused relative radioresistance of lymphocytes under aerobic conditions and, to a lesser extent, under anaerobic conditions. The slight radioresistance induced by PHA in anoxic lymphocytes apparently did not depend on an increase in DNA synthesis or on the transformation to lymphoblastoid cells. (auth)

23475 (CONF-740930-, pp 185-191) ROLE OF INDIRECT RADIATION EFFECTS ON CELL MEMBRANES IN THE IMMUNE RESPONSE. Sternglass, E. J. (Univ. of Pittsburgh). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Recent work by Petkau indicates that, in sharp contrast to the case of damage to the genes, the doubling dose for indirect radiation damage to cell membranes decreases as the dose rate declines, apparently as the result of a free-radical-mediated oxidative reaction involving O_2^-. These findings explain the earlier results of Stokke, who observed significant declines in bone-marrow cellularity of the hematopoietic stem cells involved in the immune processes at dose rates below 10^{-4} rad/min for total doses of only 0.1 to 2000 mrads, the doubling dose declining with total dose administered over periods of 6 to 18 weeks in a manner similar to that observed by Petkau. These observations, furthermore, explain the fact that erythrocyte permeability to monovalent cations can be significantly increased in occupationally exposed individuals at total doses of only 10 to 30 mR in 1 month, whereas thousands of rads are required at therapeutic dose rates. Evidence is presented suggesting the dominance of indirect, free-radical-mediated radiation effects over direct somatic mutation effects at background radiation rates on the development of cancer, leukemia, and infectious diseases from small radiation exposures encountered in the environment. The implications for the relative biological effect on the immune system of radiation at high and low dose rates are discussed. (auth)

23476 (CONF-740930-, pp 192-196) B AND T LYMPHOCYTES IN MAN. I. Effect of Infant Thymic Irradiation on the Circulating B and T Lymphocytes. Reddy, M. M.; Goh, K.; Hempelmann, L. H. (Univ. of Rochester, NY). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

B and T lymphocytes were studied in a group of adults whose thymic glands were irradiated in infancy for alleged thymic enlargement. Two independent methods were used to determine the B and T lymphocytes from each peripheral blood specimen: (1) the relative proportion of cells with surface immunoglobulins (B lymphocytes) and cells forming rosettes with sheep erythrocytes (T lymphocytes); and (2) the relative mitogenic response to phytohemagglutinin (T lymphocytes) and to pokeweed mitogen (B lymphocytes). All specimens were coded. The results obtained indicate: (1) a reduction of B and T lymphocytes; and (2) a decreased mitogenic response of lymphocytes to phytohemagglutinin and pokeweed mitogen in this group of patients as compared with the controls. These observations suggest that (1) the effect of irradiation to the thymus gland on lymphocytes is long lasting and (2) both B and T lymphocytes are affected by irradiation to the thymus gland. (auth)

23477 (CONF-740930-, pp 209-217) STUDIES ON THE LEUKEMOGENIC AND IMMUNOLOGIC EFFECTS OF RADIOSTRONTIUM (^{90}Sr) AND X RAYS IN MICE. Ito, K.; Nagao, K.; Kawamura, Y.; Yokoro, K. (Hiroshima Univ.). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The leukemogenic effect of internal irradiation with radiostrontium (^{90}Sr) was compared with that of external irradiation with x rays in ICR/JCL mice. Immunological, hematological, and cytogenetical changes were also studied during the preleukemic period in mice treated with ^{90}Sr or with x rays. A single intraperitoneal injection of 1.0 mu Ci of ^{90}Sr per gram of body weight resulted in leukemia in 62 percent of the mice. Only one of the ^{90}Sr-induced leukemias was of thymic origin. The occurrence of the leukemia was not affected by thymectomy. A fractionated whole-body x-irradiation of 680 R induced leukemia in 77 percent of the mice; the majority of the leukemias were of thymic origin. Although x-irradiation over the thymic region was ineffective in eliciting leukemia, a combined treatment of ^{90}Sr and local x-irradiation of the thymus was effective in inducing thymic lymphomas. The single intraperitoneal administration of ^{90}Sr caused an enhancement of both direct and indirect splenic plaque-forming cell (PFC) responses to sheep red blood cells, lasting for 35 days after treatment. No changes were observed in delayed-type hypersensitivity to picryl chloride. Thymectomy caused no appreciable effect in these immune responses. The fractionated whole-body x-irradiation rapidly depressed both PFC and delayed-type hypersensitivity responses, which persisted for a long period, especially in thymectomized mice. An abrupt increase of chromosomally aberrant cells in the thymus 60 days after the last x-irradiation was preceded by an increase of aberrant population in the bone marrow. On the other hand, a long-lasting appearance of aberrant population in the bone marrow and lymph nodes was observed in ^{90}Sr-injected mice. (auth)

23478 (CONF-760202-22) PERSONNEL EXPOSURE EXPERIENCE RELATED TO USE OF ^{252}Cf SOURCES. Mason, E. W.; Moser, F.; Lanzl, L. H. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA); Chicago Univ., Ill. (USA). Dept. of Radiology). 1976. Contract E(11-1)-69. 6p. Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Studies are presented of personnel exposures to ^{252}Cf neutrons and gamma radiation during dosimetry experiments in mouse phantoms, fission foil detectors, and small tissue equivalent ionization chambers. Sensitivity of film badge emulsions to observed levels of ^{252}Cf neutrons is discussed. Long-term personnel exposure histories are presented. Comparisons are made between neutron dose calculated from observed neutron-gamma ratios and the dose observed in neutron emulsions. Shielding used during experiments is described. (auth)

23479 (COO-3437-3) REVIEW OF THE GUARAPARI PROJECT. Cullen, T. L. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil)). Dec 1975. Contract E(11-1)-3437. 34p. (CONF-750671-4). Dep. NTIS $4.00.

From international symposium on areas of high natural radioactivity; Pocos de Caldas, Brazil (16 Jun 1975).

Data are summarized on the radiation dose and dose rate received by the human population of Guarapari, Brazil, a region of high level natural radioactivity. (CH)

23480 (DPSPU-75-30-7) RADIATION EXPOSURE RECORDS MANAGEMENT. Boiter, H. P. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Dec 1975. Contract AT(07-2)-1. 9p. (CONF-760202-29). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Management of individual radiation exposure records begins at employment with the accumulation of data pertinent to the in-

dividual and any previous occupational radiation exposure. Appropriate radiation monitoring badges or devices are issued and accountability established. A computer master file is initiated to include the individual's name, payroll number, social security number, birth date, assigned department, and location. From this base, a radiation exposure history is accumulated to include external ionizing radiation exposure to skin and whole body, contributing neutron exposure, contributing tritium exposure, and extremity exposure. It is used also to schedule bioassay sampling and in-vivo counts and to provide other pertinent information. The file is used as a basis for providing periodic reports to management and monthly exposure summaries to departmental line supervision to assist in planning work so that individual annual exposures are kept as low as practical. Radiation exposure records management also includes documentation of radiation surveys performed by the health physicist to establish working rates and the individual estimating and recording his estimated exposure on a day-to-day basis. Exposure information is also available to contribute to Energy Research and Development Administration statistics and to the National Transuranium Registry. (auth)

23481 (DPSPU-75-30-12) EMERGENCY RESPONSE PLANNING AT THE SAVANNAH RIVER PLANT. Cooley, R. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Dec 1975. Contract AT(07-2)-1. 7p. (CONF-760202-30). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Emergency response planning at the Savannah River Plant is a key factor in ensuring the safeguarding of personnel on the 200,000-acre plant site and in nearby communities. Planning has been continually upgraded since plant startup in the early 1950's. Detailed emergency response procedures for each plant area and major work group provide the foundation for proper response. Emergency response efforts are coordinated through an Emergency Operating Center (EOC). This facility contains life support equipment for isolation of personnel against hostile environments and extensive communications equipment. Preparations are being made to provide a computerized meteorological system in the EOC that provides real-time estimates of downwind hazards from credible accidents. Trained emergency response crews are available onplant 24 hours per day to staff the EOC and coordinate activities. Key management personnel also report to the EOC when it is activated. Unannounced exercises are conducted periodically to test response readiness. (auth)

23482 (ERDA-tr-109) RADIATION SAFETY IN OPERATING NUCLEAR POWER STATIONS. Burnazyan, A. I. Translated by W. J. Grimes from At. Energ. (USSR); 39: No. 3, 167-172(Sep 1975). 11p. Dep. NTIS $3.50.

Procedures for the radiation protection of personnel of a nuclear power plant during normal operation and in the event of a radiation accident are discussed. The protection of human populations in the plant vicinity is also considered. (CH)

23483 (NP-20819) TENTH REPORT FROM NORSK HYDRO'S INSTITUTE FOR CANCER RESEARCH FOR 1973 AND 1974. (Norsk Hydros Institutt for Kreftforskning, Oslo). 1975. 118p. Dep. NTIS (US Sales Only) $5.50.

Brief summaries are presented of research programs at the Norsk Hydro's Institute for Cancer Research, Norway, during 1973 and 1974. Included are summaries of programs involving x-radiation effects on human cells cultured in vitro. (CH)

23484 (PB-241183) NATIONAL CENTER FOR RADIOLOGICAL HEALTH RESEARCH PROJECTS SUPPORTED BY GRANT FUNDS, JUNE 30, 1967. Sabo, J. J.; Anderson, E. C. (National Center for Radiological Health, Rockville, Md. (USA)). 30 June 1967. 92p. NTIS $4.75.

The report contains a summary of active research project grants by major program areas and FY 1967 grant funds expended. Publication references are listed as well as a brief description of the objectives of the research. (GRA)

23485 (UCRL-77816) PERSONNEL MONITORING MEASUREMENTS. Griffith, R. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Feb 1976. 11p. (CONF-760301-2). Dep. NTIS $3.50.

From NBS symposium on measurements for the safe use of radiation; Gaithersburg, Maryland, United States of America (USA) (1 Mar 1976).

A personnel monitoring program must include a well integrated combination of dose determination methods, and should not depend on a single dosimetry system. Many of the necessary techniques have become well developed and dependable, such as the personnel gamma dosimeters in use today. However, other monitoring methods are still not adequate. The two most important personnel monitoring problems remaining are development of personnel neutron dosimeter and in-vivo measurement of plutonium at sublung burden levels. Although there are a few techniques under development to attack these problems, satisfactory long-term solutions will require much more work. As the developments in nuclear power and medicine continue, the need for solutions to these problems will intensify. (auth)

23486 ESTIMATE OF THE MEAN MARROW RADIOISOTOPE DOSE IN THE POPULATION OF THE PROVINCE OF VARESE. Mombelli, L.; Conte, L.; Cinquepalmi, N.; Carrier, M. (Univ., Milan). Radiol. Med.; 61: No. 5, 432-439(May 1975). (In Italian).

The mean marrow dose resulting from the diagnostic use of radioisotopes in the population of the province of Varese (about 700,000) during 1972 is estimated at about 7 mrad per person per year, with a leukaemia significant dose about 20% lower. The sampling method employed is described and the contribution of the different investigation techniques is discussed with a view to possible dose reduction. (auth)

23487 RULES FOR THE PROTECTION OF PERSONS EMPLOYED ON RADIOLOGICAL APPARATUS. Fava, G.; Latella, F.; Sichirollo, A. E.; Uva, L. (Dell'Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Radiol. Med.; 61: No. 5, 440-460(May 1975). (In Italian).

A suggested set of rules for staff working on radiological apparatus in hospitals is presented as a means of putting into effect the provisions of the relevant Decree of the President of the Republic (13 February 1964, No. 185). The pertinent articles of the decree are cited. (auth)

23488 HEALTH PHYSICS DEVELOPMENT AND RADIATION PROTECTION EXPERIENCE FOR RAPIDLY GROWING INDUSTRY AND MEDICAL PRACTICE. Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 3, 109-118(Sep 1975).

From 1st Asian regional congress on radiation protection; Bombay, India (15 Dec 1974).

This paper describes the development in health physics and the radiation protection experiences gained during the past decade in the Republic of China. Recent developments in health physics have been in the environment monitoring with reference to natural background activity and fallout due to the increasing number of nuclear reactors that are now under construction in Taiwan. The IAEA Basic Safety Standards, based on the recommendations of the International Commission on Radiological Protection, have been adopted by the Atomic Energy Council of Executive Yuan, and provided guidelines that include dose limit for groups of the general population, and maximum permissible concentrations of radioactive materials in air and water. Personnel monitoring by film badges has gradually been accepted by ionizing radiation workers and by medical groups throughout Taiwan. Bio-assays for internal exposures have long been practiced in nuclear establishments. Emphasis has been laid upon the alpha emitters such as uranium, thorium, and plutonium due to recent developments in nuclear research and nuclear power program. Area monitoring with reference to tritium has been under study to cope with the construction of four boiling water power reactors, and the operation of a heavy water reactor. (auth)

23489 RELATIVE GENETIC EFFECTIVENESS OF ^{60}Co GAMMA RADIATION DEDUCED FROM ANALYSIS OF CHROMOSOMAL DISTURBANCES IN HUMAN LYMPHOCYTES. Todorov, S. Rentgenol. Radiol.; 13: No. 3, 150-157(1974). (In Russian).

The values of the relative genetic effectiveness of ^{60}Co gamma radiation induced chromosomal disturbances in human lymphocytes by in vitro action of ^{60}Co gamma radiation and 180 Kv roentgen radiation. It was established that on subcellular level chromosomal disturbances seem a very suitable biological criterion for the evaluation of the relative genetic effectiveness. A mean relative genetic effectiveness value of 0.88 was established when analyzing the different chromosomal disturbances. This value indicates that ^{60}Co gamma radiation has a slightly lower effectiveness than roentgen radiation in inducing chromosomal disturbances in human lymphocytes in vitro. Compared with data available in the literature on the relative genetic effectiveness of ^{60}Co gamma radiation deduced upon other biological models, this value appears to be at the upper limit of the 0.5 to 0.87 span and probably emphasizes the greater radiosensitivity of human hereditary structures. (auth)

23490 INFILTRATION OF LIPIDS DURING RADIATION TREATMENT OF CANCER. Shagoyan, A. G. Vpo. Radiobiol., Sb. Tr.; 6: 143-150(1967). (In Russian).

Investigations have shown that a lipid infiltration interference occurs at various stages of radiation treatment in cancer patients.

This phenomenon strictly depends on lipid quality and degree of dispersion as well as on the therapeutic dose and the area of radiation. It has been revealed that 20% milk cream and emulsions of corn oil infiltrate better than melted non-emulsive butter and corn oil. Thus we see the necessity to use fine emulsions in therapeutic-prophylactic diets during irradiation treatment. (auth)

23491 CYTOCHEMICAL CHANGES OF GLYCOGEN IN BLOOD LEUCOCYTES AND HEMOPOIETIC ORGANS ON INJECTION OF BONE MARROW AND SYNESTROL IN IRRADIATED MICE. Kheifets, Yu. B.; Pareishvili, E. A. Vop. Radiobiol., Sb. Tr.; 6: 151-155(1967). (In Russian).

The decrease of glycogen level has been observed under the effect of ionizing radiation (650 rads) in the leucocytes of blood, spleen, and bone marrow. Seven days before irradiation synestrol was injected (0.1 ml from 2% oil solution), to one group of animals and after 24 hours irradiation bone marrow suspension was injected (60 to 70 millions cells in a physiological solution) to the other group of animals. The quantity of glycogen, reduced because of irradiation, was significantly regained in the leucocytes of blood and hemopoietic organs and contributed to the processes of recovery. The combination of synestrol and marrow did not have a favorable effect on the metabolism of carbohydrates in the cells of blood and hemopoietic organs in irradiated animals. (auth)

23492 COMPARATIVE ANALYSIS BY VARIOUS MATHEMATICAL MODELS FOR BEST FITTING OF DICENTRIC YIELDS IN HUMAN LYMPHOCYTES EXPOSED TO DIFFERENT KINDS OF RADIATION. Todorov, S. D. C. R. Acad. Bulg. Sci.; 27: No. 10, 1451-1453(1974).

Experimental data on dicentric yields induced in human lymphocytes by 180 kV of radiation, ^{60}Co gamma radiation, 50 MeV protons, and fission neutrons were the subject of mathematical-statistical analysis by the least square method, with the aid of four mathematical models: $Y = cD^2$, $Y = cD^n$, $Y = a + bD$, and $Y = a + bD + cD^2$. The analysis of the experimental data shows that radiations with low linear energy transfer are best described by the second degree polynomial $Y = a + bD + cD^2$, thus emphasizing the one-stroke component in realizing the metabolic type of aberrations; conversely, radiations with high linear energy transfer are best described by the linear model $Y = a + bD$. Radiation-induced dicentrics may equally well be described by the model $Y = cD^n$ with a varying dose exponent. (auth)

23493 INFLUENCE OF DIFFERENT KINDS OF THERAPY ON T-CELL ACTIVITY IN CHRONIC LYMPHADENOSES. Theml, H.; Begemann, H.; Issels, R.; Kaboth, W.; Schick, P.; Czempiel, H.; Winnewisser, M. (Staedtisches Krankenhaus Muenchen-Schwabing, Munich). Haematologia (Budapest); 8: No. 1-4, 43-60(1974). (In German).

The changes of T-cell activity in PHA-culture of 16 patients before, during and after 21 therapeutic series of extracorporeal irradiation of blood (ECIB) were significantly advantageous in cases of slow progress and without definite organomegaly. After spleen irradiation and after cytostatic therapy the PHA reaction was enhanced in all cases. During the therapeutic series, PHA depression caused by ECIB, cytostasis and ACTH was considerably enhanced; the weakest effect was recorded from spleen irradiation. The positive effect on T-cell activity is ascribed to the significant improvement of circulation and the regeneration of the T-cell fraction. The simultaneous follow-up of CLL kinetics allowed some therapeutical conclusions. Depletion therapy (ECIB or leucophoresis) should be applied in slow accumulative cases, while spleen irradiation is indicated in the presence of splenomegaly, and cytostatics should be applied when clinical signs of rapid cell proliferation manifest themselves [46, 48]. Alkylating agents and ACTH administered for compensation should be applied in the frame of an effective short therapy to stimulate cellular immunity. The immune defect of CLL should not be enhanced by prolonged therapy. (auth)

23494 SARCOMA OF THE UTERINE CERVIX DEVELOPING AFTER COMBINED RADIATION TREATMENT OF CANCER. Tsanev, K.; Vylkov, G. (Nauchno-Izsledovatelski Onkologichen Inst., Sofia (Bulgaria)). Onkologiya (Sofia); 11: No. 2, 100-103 (1974). (In Bulgarian)

The case history is presented of 47 year old woman with undifferentiated squamous cell epithelioma of the uterine cervix receiving combined radiation treatment and other measures to cure the malignant tumor. Nine years later (when the woman was 56) a second tumor appeared at the irradiation site—the uterine cervix. The histologic structure was of differentiated fibroleiomysarcoma. It is justifiably admitted that ionizing radiation being a blastomogenic factor has contributed to the appearance of this malignant mesenchymal blastoma, taking into consideration that the effectuated dose was approximately 10,000 roentgen. (auth)

23495 DOSIMETRY OF WHOLE-BODY IRRADIATION WITH ELECTRONS FOR THE TREATMENT OF MYCOSIS FUNGOIDES. Botha, J. C.; Kok, J. C.; Duvenage, J.; Minnaar, P. C. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Biophysics); Anderson, J. D. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Radiotherapy). S. Afr. Med. J.; 48: 2479-2481(7 Dec 1974). (In Afrikaans)

A six-field method for whole-body radiation with 3,4 MeV electrons obtained from a Mevatron 8 linear accelerator is described. The physical properties of the electrons are given, and a method is described whereby the whole-body isodose distributions can be predicted during whole-body irradiation. (INIS)

23496 ON THE PROBLEM OF THERAPEUTICALLY INDUCED RADIATION CANCER OF THE SKIN. Mitrov, G.; Ikonopisov, R. L. (Meditsinska Akademiya, Sofia (Bulgaria). Tsentyr po Onkologiys). Probl. Onkol.; 1: 87-93(1973). (In Bulgarian)

A case of therapeutically induced radiation cancer of the skin is reported occurring 52 years after X-ray epilation for a deep mycosis of the capillitium. The severe radiation damage to the exposed areas is described as well as the subsequent invasive squamous cell carcinoma destroying the underlying bone structures of the skull. The therapeutic dilemma in similar cases being pointed out good results are observed with systemic and local administration of Bleomycin. (auth)

23497 RADIOACTIVE CONTAMINATION—ASSESSMENT OF HAZARDS. McCahon, J. F. (National Radiation Lab., Christchurch (New Zealand)). N. Z. Sci. Rev.; 31: No. 4, 84-89(1974).

One of three papers delivered at a symposium, "Radioactivity and the Environment", 16 April 1973, to a general scientific audience and revised for publication. It puts current levels into perspective in relation to natural radiation exposure and readily accepted risks. Radiation dose and the conservative assumption of linear dose/effect relationship are simply explained. We all are exposed to ionising radiation from natural sources; the dose rate averages about $\frac{1}{8}$th of a rem per year. The present average population dose from all artificial sources is, in New Zealand, about 0.1 of that, most arising from medical uses. It is less in New Zealand than in many other countries because of a long established radiation protection service which helps users to minimise doses to patients and others. A person's dose from natural causes can vary by a larger amount than this, simply as the result of his place and manner of life. Thus, the risk of both somatic and genetic damage is small compared to similar risks casually accepted by the population. While radiation doses should be kept to the minimum practicable, any resulting risk can be considered acceptable if it cannot reasonably be reduced and is small compared to the many other risks normally accepted by the community, especially if there is some compensating benefit. Although about 10% of the additional radiation dose in New Zealand results from nuclear weapon testing, from which we derive no benefit, the resulting risk is negligibly small. Opposition to nuclear weapons development should be based on their purpose rather than on this very small side effect. The setting of maximum permissible doses for workers, members of the public, etc., does not mean that all will receive such doses. In fact, the average will be very much less. (auth)

23498 RADIATION HAZARDS FROM NUCLEAR WEAPONS TESTS AND THE NUCLEAR POWER INDUSTRY. O'Brien, B. J. (Department of Scientific and Industrial Research Lower Hutt (New Zealand). Inst. of Nuclear Sciences). N. Z. Sci. Rev.; 31: No. 4, 77-83(1974).

Average radiation doses that man receives from natural causes are briefly outlined; doses from cosmic-rays at sea level, in jet and supersonic transport aircraft. Typical levels of radiation dose rates of terrestrial origin, both internal and external, are presented. The global dispersal of radioactivity from nuclear weapon tests is outlined and the various contributions to radiation doses in each hemisphere are presented. Estimates are given of average annual dose rates resulting from the nuclear power industry for 1970 and 2000. A comparison is made of doses received by man from various man-made sources and finally some data on biological risks from radiation are presented, using information available in 1972. (auth)

23499 SREDSTVA INDIVIDUAL'NOJ ZASHCHITY DLYA RABOT S RADIOAKTIVNYMI VESHCHESTVAMI. (Opyt Sozdaniya Konstruktsij, Metody Otsenki, Rezul'taty Issledovanij). (Personal Protection Facilities for Handling Radioactive materials. (Experience in Designing, Evaluation Methods and Study Results)). Gorodinskij, S. M. Moscow; Atomizdat (1973). 295p.

426 refs.; 47 tables; 85 figs.

23500 INTERIM RADIATION PROTECTION STANDARDS FOR THE DESIGN, CONSTRUCTION, TESTING AND CONTROL OF RADIOISOTOPIC CARDIAC PACEMAKERS. Paris, France; Organisation for Economic Co-operation and Development (Aug 1974). 54p.

Interim Radiation Protection Standards for the Design, Construction, Testing and Control of Radioisotopic Cardiac Pacemakers, which were adopted by the OECD Council on 18th June, 1974 on recommendation by the Steering Committee for Nuclear Energy have been drawn up. The purpose of these Standards is to provide a basis on which national authorities may establish practices and procedures designed to keep the radiation risks of radioisotopic powered cardiac pacemakers to the public to a minimum; at the same time they are aimed at harmonising national legislation in this field and facilitating international travel of pacemaker bearers. These standards should be subject to review in the light of research and practical experience, and in any case before unlimited use of radioisotopic cardiac pacemakers can be authorised. Accident Analysis has been used by the experts as a basis for evaluating the risk to the integrity of the safe containment of the radioisotopic fuel in different accident conditions to which a pacemaker bearer might be subjected. It should not be regarded as an integral part of the Standards and is included only as supporting material. (INIS)

23501 GENETIC CONTROL OF HAEMOGLOBIN α-CHAIN SYNTHESIS. Huehns, E. R. (University Coll. Hospital Medical School, London). Haematologia (Budapest); 8: No. 1-4, 61-70 (1974).

The changes of T-cell activity in PHA-culture of 16 patients before, during and after 21 therapeutic series of extracorporeal irradiation of blood (ECIB) were significantly advantageous in cases of slow progress and without definite organomegaly. After spleen irradiation and after cytostatic therapy the PHA reaction was enhanced in all cases. During the therapeutic series, PHA depression caused by ECIB, cytostasis and ACTH was considerably enhanced; the weakest effect was recorded from spleen irradiation. The positive effect on T-cell activity is ascribed to the significant improvement of circulation and the regeneration of the T-cell fraction. The simultaneous follow-up of CLL kinetics allowed some therapeutical conclusions. Depletion therapy (ECIB or leucophoresis) should be applied in slow accumulative cases, while spleen irradiation is indicated in the presence of splenomegaly, and cytostatics should be applied when clinical signs of rapid cell proliferation manifest themselves. Alkylating agents and ACTH administered for compensation should be applied in the frame of an effective short therapy to stimulate cellular immunity. The immune defect of CLL should not be enhanced by prolonged therapy. (auth)

23502 RADIATION EXPOSURE OF OVARIES DURING HYSTEROSALPINGOGRAPHY. Sheikh, H. H.; Yussman, M. A. (Univ. of Louisville School of Medicine, KY). Am. J. Obstet. Gynecol.; 124: No. 3, 307-310(1 Feb 1976).

Radiation exposure to an area approximating the location of the ovaries was measured in 29 patients undergoing hysterosalpingography. A thermoluminescent crystal technique was used for some patients; a pocket dosimeter placed into the upper vagina was used for additional patients. Radiation dosage varied from 75 to 550 millirads. The weight of the patient did not affect the amount of radiation delivered to the gonads. The duration of fluoroscopic time was the major factor increasing dosage. A discussion of hysterosalpingographic technique and suggestions for decreasing gonadal irradiation during hysterosalpingography are included. (auth)

23503 INADVERTENT ^{131}I THERAPY FOR HYPERTHYROIDISM IN THE FIRST TRIMESTER OF PREGNANCY. Stoffer, S. S.; Hamburger, J. I. (Northland Thyroid Lab., Southfield, MI). J. Nucl. Med.; 17: No. 2, 146-149(Feb 1976).

Of 963 physicians surveyed to determine therapeutic attitudes toward, and experience with inadvertent radioiodine therapy for hyperthyroidism during the first trimester of pregnancy, 116 physicians (of 517 responding) reported 237 cases. Therapeutic abortion was advised for 55 patients by 22 physicans. From the 182 remaining pregnancies there were two spontaneous abortions, two stillborn, one neonate with biliary atresia, and one with respiratory distress. This complication rate was not greater than might be expected in a similar number of random pregnancies. On the other hand, six infants were hypothyroid (transient for one) and four of these were mentally deficient. Three mothers of hypothyroid infants had received radioiodine therapy in the second trimester. None of the six mothers of hypothyroid infants had had pregnancy tests prior to radioiodine therapy. Survey responses indicate that routine pregnancy testing prior to radioiodine therapy for patients in the child-bearing age is not yet a standard procedure. It should be. (auth)

Vertebrates

Refer also to abstracts 23371 and 23456.

23504 (AECL-5309, pp 51-58) POPULATION RESEARCH BRANCH. Newcombe, H. B. Nov 1975.

In Biology and Health Physics Division progress report, July 1-September 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.).

Studies of radiation induced skin tumors of rats have indicated that the higher doses are associated with greater delays in the appearance of the tumors. From this it is inferred that the direction of any such correlation between dose and latency may vary, depending upon circumstances that are not yet understood. A computer program with which to compile case histories of human hereditary and congenital disease, based on about a third of a million records of hospitalizations, registered handicaps, congenital anomaly surveillance reports and deaths, among children, was used to link these records on a trial basis with the birth registrations of the same children. As a result of the trials, final modifications to the program have been made preparatory to carrying out a production run. The resulting histories will be used, among other things, to assess the social burden, in terms of repeat hospitalizations and risks of death, from hereditary diseases of kinds that might increase in frequency due to irradiation of the germs plasm. (CH)

23505 (CONF-740930-) RADIATION AND THE LYMPHATIC SYSTEM. Proceedings of the Fourteenth Annual Hanford Biology Symposium, Richland, Washington, September 30-October 2, 1974. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D. C.). 1976. 264p. Dep. NTIS $9.00.

Separate abstracts were prepared for 33 of the 36 papers presented in these proceedings. One of the other three papers (Radiation and Lymph Node Function) was presented in abstract form only. Another of the papers (Reflections of a Wayfarer in Radiation Research) was a general paper. The third paper was a summary and comments on the conference. (ERB)

For abstracts of individual papers see: 23472-23477, 23506-23515, 23558, 23559, 23562-23569, 23581, 23582, and 23587-23591.

23506 (CONF-740930-, pp 28-35) RADIATION EFFECT ON ^{67}Ga RETENTION AND DISTRIBUTION IN MOUSE TISSUES. Mainwaring, H. R.; Swartzendruber, D. C.; Lushbaugh, C. C.; Idoyaga-Vargas, N. L.; Watson, E. E. (Oak Ridge Associated Universities, TN). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

We have studied the effect of external x irradiation on the whole-body retention and tissue distribution of gallium-67 (^{67}Ga) in mice over a period of 20 days. Adult male C57BL/6 Cum mice were injected intraperitoneally with 5 mu Ci ^{67}Ga 24 hr before, immediately before, immediately after, or 24 hr after whole-body x-ray exposure to 450 R. Control mice received ^{67}Ga injections and sham irradiation. Increased excretion and reduced soft-tissue concentrations of ^{67}Ga occurred in irradiated mice. The greatest effect was observed when the radionuclide was injected 24 hr after irradiation and assayed 24 hr later. An analysis of variance of the retention data showed that the differences between the groups were significant at the 99 percent confidence level. Exponential least-squares analysis of whole-body counting results revealed three compartments in the biological retention data. The long-lived compartment possibly corresponds to ^{67}Ga bound relatively tightly in certain body tissues and lost slowly. The two remaining compartments have been tentatively identified as circulating unbound ^{67}Ga that is lost rapidly and circulating bound ^{67}Ga that is lost less rapidly. (auth)

23507 (CONF-740930-, pp 36-45) PULMONARY LYMPHATICS AND RADIATION. Leeds, S. E. (Univ. of California, San Francisco). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Knowledge of the anatomy and physiology of the respiratory system has been more difficult to acquire than that of other organ systems owing to the complexity of the respiratory function of the lungs and to the technical difficulties involved. This is especially true of the lymphatics of the lung and is illustrated by the fact that the first measurement of pulmonary lymph flow was in 1942 by Warren and Drinker. A review of the literature reveals that few

experiments have been designed to study the pulmonary lymphatics per se in relation to the effects of external radiation or after the inhalation of radioactive particles. However, the documented involvement of hilar lymph nodes implies that the lung lymphatics have a role in transporting particles from the alveoli or malignant cells from the parenchyma. Information from clinical and experimental sources, though scattered, is fairly abundant and of value in assessing the role of the pulmonary lymphatics. Our method for collecting pulmonary lymph is presented. Studies on the pulmonary lymph flow in normal dogs and in dogs with experimental congestive heart failure are described. We irradiated (4000 to 5000 R) the medial one-third of both lungs of a series of dogs. The lymph flow of the lungs was measured immediately after the course of irradiation and after a period of about 5 months. Although lung biopsies showed characteristic radiation pneumonitis in many areas, alterations in the lung parenchyma were not quantitatively reflected in the pulmonary lymph flow either in the acute stage or after fibrosis had time to develop. (auth)

23508 (CONF-740930-, pp 77-82) RADIATION EFFECTS ON LYMPHOCYTES. Roser, B. (Univ. of Sydney). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

This review of the ontogeny of lymphocyte populations concentrates on sites of production, rates of production, and the factors governing the differentiation and longevity of the various lymphocyte pools. The physiology of the lymphocyte pools is described with particular emphasis on recirculation from blood to lymph through lymphoid tissues. The separate routes of recirculation of both thymus-derived and nonthymus-derived lymphocytes and the possible anatomical sites and mechanisms of lymphocyte cooperation are discussed. Radiation effects on lymphocyte populations are divided into two sections. First, the effects of whole-body irradiation on the total lymphocyte pools are discussed including the differential effects of irradiation on T lymphocytes, B lymphocytes, lymphoblasts, and plasma cells. The differential sensitivity of various types of immune response is correlated, where possible, with the differential sensitivity of the lymphocyte types involved. Second, experimental attempts to selectively deplete discrete subpopulations of the total lymphocyte pools, e.g., recirculating cells, are briefly discussed with particular emphasis on studies on the effects of the localization of radionuclides in lymphoid tissue. (auth)

23509 (CONF-740930-, pp 144-148) EFFECT OF IONIZING RADIATION ON THE TRANSPORT OF 2-AMINOISOBUTYRIC ACID IN RAT THYMIC AND SPLENIC LYMPHOCYTES. Kwock, L.; Wallach, D. F. H.; Hefter, K.; Schnall, S. (Tufts New England Medical Center, Boston). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The effects of gamma-irradiation on the Na^+-dependent 2-aminoisobutyric acid (AIB) transport system in rat thymic and splenic lymphocytes were compared. The results show that gamma-irradiation (0.25 to 10 krads) impairs the ability of lymphocytes from the thymus and spleen to accumulate AIB. The radiation effect is specific for this transport system since the transport of 1-aminocyclopentane-1-carboxylic acid (ACPC), a Na^+-independent system, is not affected in either organ by the levels of radiation used. This suggests that the cells are not becoming leaky and that the mechanism which affects AIB transport in thymic lymphocytes is the same in splenic lymphocytes. The radiation effect is both time and dose dependent, but anomalies were found in the uptake of AIB in the splenic lymphocytes as a function of both parameters in irradiated and nonirradiated splenic lymphocytes. These anomalies suggested that splenic lymphocytes contained a sensitive population of cells. The effect of radiation on lymphocytes from spleens treated with anti-rat lymphocyte serum (ALS) was compared with the effect on lymphocytes from nontreated spleens. The population of lymphocytes remaining after ALS treatment was much more radioresistant. This indicated that the sensitive population of lymphocytes in the spleen with respect to AIB transport was a thymus-derived cell population. Previously, insulin, which increases 2-aminoisobutyric acid influx by increasing the maximal rate of uptake, V/sub max/, was found to protect the thymocyte 2-aminoisobutyric acid system against the effects of radiation. In the case of splenic lymphocytes, no such protective effect was found. In both cases insulin (10^{-7} M to 10^{-12} M) stimulated AIB transport by 10 to 15 percent. This indicated that splenic lymphocytes do have insulin receptor sites but that the mechanism of the insulin radioprotective effect observed in thymocytes is not functioning in splenic lymphocytes. (auth)

23510 (CONF-740930-, pp 149-152) CHRONIC BLOOD IRRADIATION: A NEW APPROACH. Hungate, F. P.; Riemath, W. F.; Bunnell, L. R.; Gillis, M. F. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Extracorporeal irradiation of blood is beneficial in suppressing early rejection of renal allografts and in treating chronic lymphocytic leukemia. Previously, nearly all blood irradiation has involved brief intermittent exposures with high dose rates. The small amount of data available involving chronic irradiation suggests that doses given chronically at lower rates are more effective in suppressing graft rejection. However, no suitably portable device has been available to permit chronic irradiation. This work has been directed toward developing a fully portable irradiator. After preliminary testing of a variety of source materials, ^{170}Tm was selected for its favorable beta energy, low cost, and compatibility with the fabrication requirements. The body of the irradiator is cast from polyfurfuryl alcohol with subsequent high-temperature conversion to vitreous carbon. By sequential layering of the alcohol and suspending of $^{169}Tm_2O_3$ in the midlayer, a unit is produced without any radiation exposure and with the source material contained on both a macro and a micro scale. Exposure of the unit to reactor neutrons produces ^{170}Tm without activation of the vitreous carbon. A ^{170}Tm irradiator giving a transit dose of 16 rads (100 ml/min flow) was connected in a carotid-jugular shunt on a 20-kg goat. Lymphocyte levels decreased to about 15 percent of the preexposure level during the first week and thereafter slowly rose to about 50 percent of preexposure levels 2 months after exposure. Reciprocal skin grafts made at the end of irradiation (12 days) were rejected at 12 days on the nonirradiated control and at 24 days on the irradiated goat. These results are consistent with data reported on chronically irradiated baboons even though the dose rate for the present test was only about one-fourth that for the baboons. (auth)

23511 (CONF-740930-, pp 153-164) SELECTIVE IMMUNOSUPPRESSION BY RADIATION. Chanana, A. D.; Cronkite, E. P.; Joel, D. D. (Brookhaven National Lab., Upton, NY). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The historical aspects of selective irradiation of lymphocytes are reviewed as well as the problems concerned with dosimetry and the radiosensitivity of circulating blood elements other than lymphocytes. The possibilities of perturbations in steady-state lymphocytopoiesis which might be triggered by products of radiation-induced cell death are presented; however, the parameters investigated thus far, such as the degree of lymphocytopenia, thoracic duct lymphocyte output, and cell-cycle times of thoracic duct lymphocytes, have failed to reveal any such perturbations. Studies in adrenalectomized calves have failed to confirm the notion that lymphocytopenia after extracorporeal irradiation of blood and lymph might primarily be accounted for by stress-induced corticosteroid hormonal activity. Of the various techniques, only local-graft irradiation and extracorporeal irradiation of blood (ECIB) have found clinical application. The results obtained are encouraging and indicate a need for additional, well-controlled clinical trials, especially concerning the role of ECIB as an adjunct to standard immunosuppressive therapy. The experimental results with extracorporeal irradiation of lymph have also established the potential of this technique for clinical application. There is an urgent need for studying the influence of irradiation on various subpopulations of lymphocytes with regard to their functional capabilities and in particular with regard to their reproductive potential. Possible influence of selective blood irradiation on circulating stem cells in blood needs to be evaluated. (auth)

23512 (CONF-740930-, pp 169-174) RADIATION EFFECTS ON THE FORMATION OF EFFECTOR CELLS AND ON THE CYTOTOXICITY OF THE EFFECTOR CELLS. Song, C. W.; Levitt, S. H. (Univ. of Minnesota, Minneapolis). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The effect of radiation on the transformation of lymphocytes to antigen-specific immune lymphocytes and also on the cytotoxicity of the immune lymphocytes against allogeneic tumor cells was studied. Irradiation of peripheral lymphocytes of rats with 1000 rads of X rays did not significantly impair the phytohemagglutinin-induced blastogenesis and DNA synthesis, but it inhibited the

subsequent division of the blast cells. The cytolysis of tumor cells in vitro by splenic immune lymphocytes was quantitated with release of ^{125}I-labeled iododeoxyuridine (^{125}I-IUdR) from the tumor cells labeled with the isotopes. The immune lymphocytes were rather radioresistant with regard to their cytotoxicity against the tumor cells. It was concluded that irradiation-induced immunosuppression might be due, not to a destruction of cytotoxic effector cells, but mainly to the suppression of formation of effector cells. (auth)

23513 (CONF-740930-, pp 175-184) RADIOSENSITIVITY OF ANTIBODY RESPONSES AND RADIORESISTANT SECONDARY TETANUS ANTITOXIN RESPONSES. Stoner, R. (Brookhaven National Lab., Upton, NY); Terres, G.; Cottier, H.; Hess, M. 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Primary tetanus antitoxin responses were increasingly repressed in mice when gamma radiation doses of 100 to 400 rads were delivered by whole-body exposure prior to immunization with fluid tetanus toxoid (FTT). Nearly normal secondary antitoxin responses were obtained in mice exposed to 600 rads of gamma radiation 4 days after secondary antigenic stimulation with FTT. A rapid transition from radiosensitivity of the antibody-forming system on days 1 to 3 was followed by relative radioresistance on day 4 after the booster injection of toxoid. Studies on lymphoid cellular kinetics in popliteal lymph nodes after injection of ^{3}H-thymidine (^{3}H-TdR) and incorporation of ^{3}H-L-histidine into circulating antitoxin were carried out. Analysis of tritium radioactivity in antigen–antibody precipitates of serums 2 hr after injection of the labeled amino acid revealed maximum incorporation into antibody around day 7 after the booster in nonirradiated controls and about day 12, i.e., 8 days after irradiation, in experimental mice. The shift from radiosensitivity to relative radioresistance was attributed to a marked peak of plasma-cell proliferation in the medulla of lymph nodes on day 3. Many medullary plasma cells survived and continued to proliferate after exposure to radiation. Germinal centers were destroyed by radiation within 1 day. Since antibody formation continued after exposure to radiation and after the loss of germinal centers, this supports the view that germinal-center cells were involved more in the generation of memory cells than in antibody synthesis. (auth)

23514 (CONF-740930-, pp 203-208) HISTOPATHOLOGIC ASPECTS OF RADIATION EFFECTS ON LYMPHATIC TISSUES AND MALIGNANCIES. Lushbaugh, C. C.; Swartzendruber, D. C. (Oak Ridge Associated Universities, TN). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Morphologic study with the light microscope remains our most facile and rapid means of tissue identification, diagnosis and staging of diseases, and demonstration of radiation-induced and other toxic effects. The inadequacy of its use alone, however, for the solution of biologic problems is nowhere better illustrated than in such studies on lymphatic tissues as are reported in this symposium. Nearly every classical concept concerning lymphocyte biology and disease derived by morphologic methods has been challenged or disproved in recent years by applications of nonmorphologic technologies. Studies with light and electron microscopy in combination with cell-labeling techniques, histochemical methodology, virology, immunology, and radiation biology have corrected many of our misconceptions and provided unifying concepts of lymphatic-tissue structure and function which explain anew our observations of the past. For example, nearly everyone now accepts the biologic role of viruses in what once were considered radiation-caused neoplasms in rodents, although whether the role of radiation and other physical and chemical insults in human carcinogenesis is direct or indirect is still to be elucidated. Also, the exact relations that obtain between radiation and cancer induction via viruses even in well-studied rodent systems remain to be determined; and here morphologic studies continue to play an important integrating role for the multidisciplinary studies that are required. (auth)

23515 (CONF-740930-, pp 230-238) RETICULOENDOTHELIAL NEOPLASMS IN C57 BLACK MICE AFTER FAST-NEUTRON IRRADIATION AT LOW DOSAGE. Mewissen, D. J.; Rust, J. H. (Univ. of Chicago). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D. C.).

In many inbred strains of mice the modulation of the basic control tumor pattern by ionizing radiation is operative primarily on the reticular tissue. This phenomenon seems more productive with high linear energy transfer radiation, particularly neutrons. The results reported in this paper are based on a total of 1963 C57 Black mice, subline 6, of either sex. From each litter animals were randomly assigned to control and treatment groups and were neutron-irradiated at 3.2, 4.5, 6.3, 8.8, and 12.3 rads of single exposure. In male and female irradiation groups, incidence rates for lymphocytic lymphomas were sharply decreased by neutron irradiation at all dose levels. In reticulum-cell sarcomas an interesting contrast was observed. First, the tumor type shifted almost entirely from type A to type B. Second, all specific incidence rates were markedly increased by radiation, both for male and female mice at all dose levels. Our data suggest the existence of an intercompetitive process triggered or accelerated by radiation. (auth)

23516 (JPRS-64532) EFFECTS OF NONIONIZING ELECTROMAGNETIC RADIATION. Potapov, S. L. Translated from various journals. 76p. NTIS $4.75.

Contents: Mouse bone marrow reaction to altered UHF millimeter irradiation parametric variation; Changes in the peripheral blood of guinea pigs induced by a three centimeter electromagnetic field; The effects of ephedrine and nikethamide on microwave-exposed mice; Participation of the central nervous system in the regulation of carbohydrate metabolism in animals exposed to an ultra-high-frequency field; Maximum flux density of the power from a broadcase satellite in the 620–790 MHz frequency band; Environmental protection from electromagnetic radiation are described. (GRA)

23517 (NIRS-14, pp 47-60) MEDICAL STUDIES. Sep 1975. In annual report, 1974.

Summaries are presented of research in the following areas: cerebro-medulla oblongata hemorrhage in SPF mice irradiated with ^{137}Cs-gamma rays; optimum fractionation regime for bleomycin treatment; automated diagnosis of ICC from roentgenograms; optimum treatment schedules in radiotherapy; measurement of the uniformity of scintillation cameras; x-ray videodensitometry; ^{86}Rb uptake by red cells in patients with benign and malignant breast tumors; use of scinti-tomograms on brain tumors; responses of the tumor next to single x-ray irradiations; NIRS medical data processing system for radiotherapy; repair of potentially lethal damage in acutely and chronically hypoxic tumor cells in vivo; cytogenetic study of the fisherman exposed to fallout radiation in 1954 (20 year followup); radiotherapy of recurrent cancer of the cervix uteri; and correlation between gastrointestinal absorption and uptake by the critical organ of ^{85}Sr, ^{109}Cd, ^{131}I, and ^{203}Hg. (ERB)

23518 (UCD-472-122) ANNUAL REPORT, FISCAL YEAR 1975. Foldman, M. (California Univ., Davis (USA). School of Veterinary Medicine). Jun 1975. Contract E(04-3)-472. 231p. Dep. NTIS $7.60.

Separate abstracts were prepared for the 33 papers of the report. Twenty-four were included in Nuclear Science Abstracts, and all were included in ERDA Energy Research Abstracts. (HLW)

For abstracts of individual papers see: 23455, 23519–23525, 23570–23577, 23592–23597, and 23612.

23519 (UCD-472-122, pp 2-12) PATHOLOGY IN A LIFE-SPAN STUDY OF X-IRRADIATED FEMALE BEAGLES. Chrisp, C. E.; Phemister, R. D.; Andersen, A. C. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Clinical records, gross necropsy records, slides, and stored tissues of x-irradiated beagles were reviewed. Tables are presented to show preliminary determinations of causes of death, neoplasms found, and number of dogs at risk in relation to age and dose level. Mammary and ovarian tumors were more numerous in irradiated beagles and were partially responsible for shortening of lifespan. Neoplasms of the urogenital system were also increased in irradiated groups. (HLW)

23520 (UCD-472-122, pp 13-16) RADIOSENSITIVITY OF THE FETAL BONNET MONKEY OVARY TO FRACTIONATED X-IRRADIATION. Andersen, A. C.; Hendrickx, A. G.; Newman, L. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Radiation damage to the ovary of the fetal bonnet monkey (M. radiata) from fractionated x-ray exposures of 11.5 rad (total 200

rad) varies somewhat, depending on the time in utero when oogenesis occurs. Follicle counts in twelve x-irradiated monkeys give evidence that 77 to 135 days postcoitum is a radiosensitive time for ovaries in most fetuses, but an occasional fetus is not sterilized by x-irradiation during this period if oogenesis occurs later in gestation. Apparently, prenatal irradiation can also delay oogenesis in this species. (auth)

23521 (UCD-472-122, pp 17-23) RESPONSE OF THE GENITAL TRACT TO GONADOTROPIN STIMULATION OF THE AFOLLICULAR (X-IRRADIATED) OVARY IN THE BEAGLE. Andersen, A. C.; Momeni, M. H.; Stebbins, E. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

The morphologic response of the genital system in 16 beagles with afollicular (x-irradiated) ovaries has been examined following follicle and luteinizing hormone treatment. The dogs received a single brief exposure of 5 R daily or 10 R on alternate days from birth to 60 days of age (total 300 R). When the dogs were 7 months or older, the hormone treatment caused enlargement of the afollicular ovary and specific changes resembling proestrus in the oviduct and uterus; the vagina and vulva did not respond to the treatment. (auth)

23522 (UCD-472-122, pp 24-27) ATTEMPTS TO STERILIZE TILAPIA ZILLII BY GAMMA IRRADIATION FOR INTRODUCTION INTO AN ECOSYSTEM. Andersen, A. C.; Momeni, M. H.; Nelson, S. G.; Yeo, R. R. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Tilapia zillii, a cichlid fish from northern Africa, was introduced into Florida, Alabama, Arizona, and California for aquatic weed control. A study was conducted to determine if the germ cells of the fish could be selectively destroyed by ionizing radiation in doses below the lethal range in order to obviate the potential ecological problems associated with proliferation of an exotic fish species. No demonstrable effect on the gonads was shown by gamma doses up to 3300 R. (HLW)

23523 (UCD-472-122, pp 51-73) HEMATOLOGICAL EFFECTS: COMPARATIVE STUDIES ON THE RADIATION SURVIVAL CHARACTERISTICS IN VIVO AND IN VITRO OF BONE MARROW-DERIVED CLONOGENIC POPULATIONS (CFU-C AND PFU-C) AND SOME OBSERVATIONS ON BONE MARROW CELLULARITY IN BEAGLES. Wilson, F. D.; O'Grady, L.; Momeni, M.; Wheeling, J. A.; Klein, K.; Graham, R.; Jow, N.; Di Bartola, S. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Data accumulated for the hematological effects program are reviewed. Particular emphasis is given to the effects of acute and chronic irradiation on hematopoietic progenitor populations (CFU-C, colony-forming units in culture) and "candidate" mesenchymal progenitors (PFU-C, plaque-forming units in culture) using methylcellulose bone marrow culture systems and both in vivo and in vitro radiation exposure protocols. Preliminary results of studies on the temporal effects of acute x-irradiation on the capacity of PFU-C to generate colony stimulating activity (CSA) are also presented. The results of such experiments are providing the basis upon which future RBE studies on a variety of nuclides will be structured. Data (including age related changes) is also presented on in vivo bone marrow cellularity determinations, as well as for marrow stem cell quantitative studies using nondestructive techniques for normal Beagles. In these studies, two techniques for correction of variable effects of hemodilution are compared. Such studies are also providing baseline data for the ^{60}Co hematological effects program. (auth)

23524 (UCD-472-122, pp 109-110) EFFECTS OF ENVIRONMENT, RADIATION, AND DISEASE ON SERUM COPPER AND ZINC LEVELS IN THE BEAGLE WITH APPLICATIONS TO MAN. Fisher, G. L. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Serum copper and zinc levels were elevated in beagles with radioinduced osteosarcoma and human patients with primary osteosarcomas had elevated serum copper and zinc levels. Exposure to ^{226}Ra or ^{90}Sr did not alter serum copper or zinc, but serum zinc levels were elevated and serum copper levels were depressed in dogs receiving ^{60}Co whole-body irradiation. (HLW)

23525 (UCD-472-122, pp 137-138) TRANSPLANTATION OF CANINE OSTEOSARCOMA INTO NUDE MICE. Shifrine, M.; Taylor, N.; Holloway, G.; Arnstein, P. R.; Chrisp, C.; Pool, R.; Whaley, C. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Osteosarcomas from dogs were inoculated subcutaneously into mice. Sixty days later six mice had tumors that gradually increased in size. All tumors were undifferentiated sarcomas. Karyotypes of osteosarcomas grown in tissue culture and of tumors from mice inoculated with the culture were similar with two marker chromosomes. It was thus shown that radioinduced osteosarcomas can be cultivated in tissue culture while retaining their marker chromosomes and malignancy. (HLW)

23526 COMBINATION OF CHEMICAL RADIOPROTECTORS: ITS EFFECT ON THE SURVIVAL OF IRRADIATED RATS. Nikalov, I.; Pantev, T.; Bokova, N. Acta Med. Bulg.; 2: No. 1, 7-12(1974). (In Russian).

The radioprotective effect was studied of a combination of three chemical radioprotectors in nontoxic doses—Adenosinetriphosphate (ATP), Serotonine and S-2-benzimidazolil-mercapto-proprio-N-(p-tolyl) hydrazimide—on albino rat survival following whole-body exposure to 500–1000 R of x rays. A dose reduction factor was calculated as the integral criterion for protection. A reliable radioprotective effect was obtained with the combined administration of these three radioprotectors having different mechanisms of action and used in doses several times lower than the maximally admissible ones. This combination proved to be also differentially effective on isolated syndromes of radiation sickness. (auth)

23527 SUMMARIES OF THE PAPERS PUBLISHED IN THIS SYMPOSIUM. Papoyan, S. A.; Kamalyan, L. A.; Ter-Poposyan, R. A.; Engoyan, M. N. Vop. Radiobiol., Sb. Tr.; 6: 15-25(1967). (In Russian).

The results of immunomorphological investigations carried out by a luminescent microscope have shown the efficiency of this method to reveal the features of cellular changes in the organs of the reticuloendothelial system of irradiated and immunized animals. There is a pronounced difference in the intensity and speed of development of the plasmocyte reaction in irradiated and unirradiated animals. In irradiated animals this reaction develops slower, with less intensity whereas in immunocompetent cells the protein synthesis proceeds slowly. (auth)

23528 CHANGES OF FREE AND PROTEIN AMINO-ACIDS OF BLOOD SERUM IN IRRADIATED AND IMMUNIZED RABBITS. Kamalyan, L. A.; Buniatyan, L. O. Vop. Radiobiol., Sb. Tr.; 6: 27-33(1967). (In Russian).

By irradiating animals with a dose of 700 rads, significant changes have arisen in the quantitative proportions of free and protein animo-acids of the blood serum on the 7th and 14th days, which later disappear by the 30th day. On the 7th day a sharp decrease of free amino-acids is revealed as a result of the strengthening of the decaying process of amino-acids in the irradiated organism. The increase of the amount of some free amino-acids such as serine, glycine, glutamine acid, trionine, and alanine is caused by irradiation as well as by vaccination in rabbits. Irradiation evokes sharp and long decrease of the level of sulphur-containing free and protein amino-acids such as cysteine and methionine. Taken alone anti-smallpox vaccination does not evoke marked quantitative changes of free amino-acids but rather increases the amount of most of the protein amino-acids. The definite decrease of the amount of free amino-acids and at the same time the increase of the amount of protein amino-acids under the influence of monoethanoleamine give evidence of strengthening of the synthesis of serum proteins. (auth)

23529 ANTISMALLPOX VACCINATION AS A FACTOR OF INCREASE OF RADIATION RESISTANCE. Kamalyan, L. A. Vop. Radiobiol., Sb. Tr.; 6: 43-49(1967). (In Russian).

After 48 hours, 15 days, and 30 days of anti-smallpox vaccination of rabbits with a dose of 700 rads and 1000 rads, we notice an increase in vitality. The highest radiation resistance (statistically probable) is to be observed on the 30th day after vaccination. The degree of radiation resistance depends on the depth of immunological changes. (auth)

23530 RESTORATION OF LYMPHOID TISSUE AND THE NATURE OF PLASMOCYTE REACTION IN IMMUNIZED AND IRRADIATED RABBITS. Ter-Pogosyan, R. A.; Malikoyan, S. A.; Grigoryan, D. G. Vop. Radiobiol., Sb. Tr.; 6: 51-56 (1967). (In Russian).

The morphological changes of the reticuloendothelial system were studied before rabbits were irradiated with 1000 rads of x rays. They were previously immunized by smallpox detritum. The results obtained have shown that the degree of decay of the lymphoid and the period of its restoration are the same before irradiation in revaccinated rabbits and control groups. On the 30th day of radiation sickness we notice a great increase in the number of lymphoblasts and blasts in immunized and control rabbits, which indicates lymphopoiesis activation whereas after irradiation the plasmocyte reaction develops later in immunized rabbits compared with the control animals. (auth)

23531 DEPENDENCE OF RADIOSTABILITY, CAUSED BY VACCINATION, ON THE DEGREE OF IMMUNOLOGICAL RECONSTRUCTION OF THE BODY. Ter-Pogosyan, R. A.; Grigoryan, D. G.; Malikoyan, S. A. Vop. Radiobiol., Sb. Tr.; 6: 57-63(1967). (In Russian).

The vitality and certain indexes of gravity of radiation syndrome have been studied in various animals under conditions of long intervals of immunization and irradiation. Experiments have been carried out on rabbits, guinea-pigs, and white mice. These animals differ in sensitivity toward vaccine virus. Our purpose was to clarify the role of specific immunity in creating radiostability. The results of the experiments have shown that the vitality of irradiated rabbits with a dose of 1000 rads is much higher in previously revaccinated sub-ground of animals (57%), in comparison to nonimmunized animals (14.4%). (auth)

23532 SPREAD AND REPRODUCTION OF SMALLPOX VACCINE IN IRRADIATED RABBITS. Vartevanyan, Zh. Ts.; Kamalyan, L. A.; Engoyan, M. N.; Zakaryan, V. K. Vop. Radiobiol., Sb. Tr.; 6: 65-71(1967). (In Russian).

Viremia is observed comparatively soon and is conserved a long time in rabbits irradiated with a dose of 700 rads and then immunized with smallpox vaccine. The virus appears comparatively soon in the organs of the reticuloendothelial system and in the liver. In this case a strong reproduction of the virus is noted in the organs. (auth)

23533 SOME REGULARITIES OF ACTIVITY CHANGE OF BLOOD SERUM COMPLEMENT IN IRRADIATED AND IMMUNIZED ANIMALS. Grigoryan, D. G.; Ter-Pogosyan, R. A.; Malikoyan, S. A. Vop. Radiobiol., Sb. Tr.; 6: 73-77(1967). (In Russian).

The changes of complementary activity were studied in irradiated and immunized animals. The results of the experiments have shown that in previously immunized rabbits irradiation causes a short decline of complementary activity of blood serum. In guinea pigs that have not been immunized as a result of irradiation we notice a decline of complementary titer on the 7th to 10th days of sickness which is not to be seen in immunized animals. The maximal development of radiation bacteremia is observed in the period of decline of complementary activity in rabbits and guinea pigs. (auth)

23534 SERUM THERAPY OF SMALLPOX VACCINE INFECTION AND SERUM PROPHYLACTICS IN IRRADIATED AND NON-IRRADIATED HEN EMBRYO. Vartevanyan, Zh. Ts. Vop. Radiobiol., Sb. Tr.; 6: 79-84(1967). (In Russian).

The prophylactic injection of specific hyperimmune serum (24 and 2 hours before infection and simultaneously with virus injection) has given a good result in non-irradiated as well as in irradiated hen embryo, but the degree of neutralization in the latter was low. In non-irradiated embryo we notice a curing effect only when it is injected 2 and 24 hours after virus injection whereas in irradiated embryo little effect is noticed only when injection is performed 2 hours after infection. (auth)

23535 IMMUNOMORPHOLOGICAL CHARACTERISTICS OF ANIMALS FOLLOWING IRRADIATION AND VACCINATION. Engoyan, M. N. Vop. Radiobiol., Sb. Tr.; 6: 85-91(1967). (In Russian).

Anti-smallpox vaccination results in the development of plasmocyte reaction, which begins from the 2nd day after virus injection and reaches its maximum on the 14th day, then gradually declines up to the 30th day. In x-irradiated animals with 700 rads and vaccinated after 48 hours plasmocyte reaction develops slower and less intensively. A certain regularity has been revealed between the development of plasmocyte reaction and the concentration of anti-smallpox antibodies in the organs and blood. (auth)

23536 EFFECTS OF HYALURONIC ACID AND CERTAIN DRUGS ON EXPERIMENTAL POSTIRRADIATION BACTEREMIA. Ter-Avetisyan, A. T.; Alaverdyan, M. I. Vop. Radiobiol., Sb. Tr.; 6: 93-100(1967). (In Russian).

Experiments were carried out on 800 white mice. It has been revealed that after irradiation with a dose of 400 rads the injection of vitreous body has almost no effect on the development of postirradiation bacteremia, but when irradiated with a dose of 200 rads microbial invasion of blood decreases significantly. The combination of hyaluronic acid (vitreous body) with other drugs (adrenalin, biomycin, vicasol) gives a better anti-irradiation curing effect, than the drugs without a vitreous body. The results of treatment of irradiated animals (with vitreous body), after irradiation, show that the mechanism of the positive effect of the vitreous body is due to the decrease of the elevated tissue penetration. It is natural that this fact in its turn decreases the hemorrhage phenomena and postirradiation auto-infection which is specific for radiation sickness. (auth)

23537 BACTEREMIA AND PROTEIN METABOLISM UNDER THE INFLUENCE OF VITREOUS BODY AND LIDAZE IN IRRADIATED RABBITS. Papoyan, S. A.; Ter-Avetisyan, A. T.; Gambaryan, L. S.; Alaverdyan, M. I.; Shukhyan, V. M.; Garibyan, L. A. Vop. Radiobiol., Sb. Tr.; 6: 101-107(1967). (In Russian).

Experiments were conducted on 28 rabbits. Under the combined influence of x-rays (650 rads) and hyaluronidase (32 units) a more intensive development of bacteremia takes place than by irradiation alone. Hyaluronic acid (vitreous body) promotes a more intense radioprotective effect. It is assumed that the decrease of the tissue penetration which was high in the postirradiated period is the result of the positive effect of the vitrous body. This fact in its turn must promote a decrease of hemorrhage phenomena and postirradiation infection. At the same time certain changes were noticed in protein metabolism. (auth)

23538 DEVELOPMENT OF EXOGEN STAPHYLOCOCCUS INFECTION DUE TO HYALURONIDASE AND HYALURONIC ACID INJECTION IN IRRADIATED MICE. Alaverdyan, M. I.; Okhikyan, V. M. Vop. Radiobiol., Sb. Tr.; 6: 109-113(1967). (In Russian).

Experiments were carried out on mice irradiated with a dose of 650 rads. The data show the role of hyaluronidase–hyaluronic acid enzyme–tissue system in the pathogenesis of radiation sickness. It has been revealed that under the combined effect of x rays and hyaluronidase there was in white mice a rise of exogen staphylococcus bacteriaemia, a fall of weight, and a decrease of leucocytes, and on the contrary when hyaluronic acid and staphylococcus culture are injected no staphylococcus in blood is noticed. (auth)

23539 LOCAL RADIOPROTECTIVE EFFECTS OF ANODIC CURRENT. Dadoyan, G. S.; Ambartsumyan, S. G.; Davtyan, R. A. Vop. Radiobiol., Sb. Tr.; 6: 115-119(1967). (In Russian).

Anodic stimulations were carried out to weaken the reaction of skin to irradiation in animals. The experiments were made on 60 white rats. The experiments have shown that local anodizing of the skin considerably weakens the dangerous effect of x-rays. In the control groups erythema, epidermitis and other symptoms were noticed but the above mentioned symptoms have not been observed or were in a very weak form in experimental groups. In the peripheral blood of control animals after irradiation a pronounced leukopenia was noticed whereas in experimental groups no such phenomenon was seen. (auth)

23540 CHEMICAL PROTECTION AND COMBINED TREATMENT OF ACUTE RADIATION SICKNESS DURING X-IRRADIATION WITH SUBLETHAL AND LETHAL DOSES IN MICE AND RABBITS. Airapetyan, F. O. Vop. Radiobiol., Sb. Tr.; 6: 121-126(1967). (In Russian).

Experiments were carried out on 600 white mice and 60 rabbits that were exposed to x-irradiation with sublethal and lethal doses (500 rads, 650 rads, 700 rads, 900 rads). The results show that the percent of vitality was almost 2 to 2½ times higher 10 minutes before irradiation in white mice and rabbits. They were given cysteine for protective purposes and were irradiated with different doses and immediately cured by various methods and thereby compared with the control group. Upon irradiation with absolute lethal doses, when vitality is 0.0% in control animals, in experimental animals it is 90 to 95%. Postirradiation bacteremia is weak or does not develop at all in control and cured animal groups. The process of recovery is quick, hemorrhage is less pronounced, and the prophylactic and curing effect of the preparations used are evident in comparison with the control group which have not received drugs. (auth)

23541 COMBINED EFFECT OF A VITREOUS BODY, VITAMINS (B_6B_{12}) AND STREPTOMYCIN ON THE COURSE AND OUTCOME OF EXPERIMENTAL ACUTE RADIATION SICKNESS. Papoyan, S. A.; Airapetyan, F. O.; Alaverdyan, M. I. Vop. Radiobiol., Sb. Tr.; 6: 127-132(1967). (In Russian).

Experiments were carried out on 400 white mice given x-irradiation (500 rads and 700 rads). Immediately after irradiation the drugs mentioned above were injected into the experimental animals in different combinations. The results have shown that the percent of vitality of white mice irradiated with 500 rads and immediately cured with a vitreous body, vitamins (B_6, B_{12}), and streptomycin is almost 2 to 2.5 times higher than in the control group (untreated animals). Besides, in animals cured with the combinations of drugs the sickness proceeds incomparably lightly, the hemorrhage features are weakly expressed, the recovery processes advance quicker, and finally a well expressed therapeutic effect is noticed in comparison with the control group. Almost the same picture is to be noted during irradiation with lethal doses (L 100/30). Moreover, when the death rate is

100% in the control group the percent of vitality is higher (64%) in mice treated with the above drugs. (auth)

23542 SOME INDICATIONS OF VITALITY AND CARBOHYDRATE METABOLISM IN IRRADIATED ANIMALS. Vlasenko, S. P.; Arutyunyan, R. K.; Khachkavanktsyan, A. S. Vop. Radiobiol., Sb. Tr.; 6: 133-141(1967). (In Russian).

The present paper shows that marked changes of carbohydrate metabolism take place in the body under the influence of ionizing rays. Meanwhile, the harmful effect of x-rays significantly eases; some indications of carbohydrate energetic metabolism improve upon direct current application. When radiation is performed simultaneously with anodic galvanization of the brain, we notice a fall in the death rate in animals and the normalizing of carbohydrate metabolism. (auth)

23543 EFFECTS OF IONIZING RADIATION ON THROMBOPOIESIS. Batikyan, I. G. Vop. Radiobiol., Sb. Tr.; 6: 157-162 (1967). (In Russian).

A dose of ionizing radiation (800 rads) brings forth obvious changes in the megakaryocytes of bone marrow. Severe radiation sickness is accompanied by the decrease of megakaryocytes which is particularly apparent on the 5 to 10th days. Simultaneously, degenerative changes are to be seen revealing a decrease of mature, young megakaryocytes as well as the increase of degenerative, involutive forms and bare nuclei. A decrease of megakaryocyte activity is also noticable. The increase of giant forms of mature megakaryocytes is specific and their amount does not drop to normal even at the end of our investigation period. (auth)

23544 CHANGES OF SKIN REACTIVITY IN RESPECT TO STAPHYLOCOCCUS IN IRRADIATED RABBITS. Okhikyan, V. M. Vop. Radiobiol., Sb. Tr.; 6: 163-165(1967). (In Russian)

Investigations have shown that hyaluronidase promotes rapid penetration of microorganisms causing skin inflammation as a result of skin hyaluronic acid hydrolysis in irradiated rabbits. During the first 2 weeks of radiation sickness skin penetration rises as a result of which the inflammation process is strongly expressed. The above mentioned changes are expressed weakly during partial irradiation. Skin penetration begins to become normal from the 30th day of the postirradiation period probably on account of the rise of hyaluronic acid level. (auth)

23545 EFFECTS OF IONIZING IRRADIATION ON GLYCOGEN CHANGES IN THE THROMBOCYTES OF PERIPHERAL BLOOD AND IN THE MEGAKARYOCYTES OF BONE MARROW. Batikyan, I. G. Vop. Radiobiol., Sb. Tr.; 6: 167-173(1967). (In Russian)

A significant decrease of glycogen contents is to be noticed as a result of x-irradiation with a dose of 800 rads in the thrombocytes of peripherial blood and in the megakaryocytes of bone marrow in rabbits. The content of glycogen begins to decrease in the thrombocytes immediately after irradiation from the beginning of the first hours. At the end of the period the number of platelets rich with glycogen is not complete while the quantity of glycogen thrombocytes with moderate content reaches the primary degree. The decrease of glycogen quantity in megakaryocytes takes place from the 5 to 13th day after irradiation while on the 25 to 30th day the quantity of glycogen fully recovers in cells. (auth)

23546 EFFECT OF MANGANESE-54 AND EXTERNAL γ-IRRADIATION ON THE QUANTITY AND METABOLISM OF PHOSPHOLIPIDS OF THE BRAIN AND LIVER OF RATS IN CHRONIC EXPERIMENTS. Znamenskii, V. V.; Orlyanskaya, R. L. Vop. Radiobiol., Sb. Tr.; 6: 175-180(1967). (In Russian)

The present paper is dedicated to the comparative study of the effect of manganese 54 on rats (without a carrier), administered orally in amounts of 11.5 m.c.c./k.g. and external γ irradiation in comparable doses. The quantity and metabolism (^{32}P) of phospholipids of the brain and liver were determined during the period of 12 months. The results have confirmed the statistical processing with the help of the Moldenhauer factor. A distinct difference has been established in the action of incorporated Mn 54 and external γ irradiation. Under the effect of Mn 54 as early as 3 months the increase of the quantity and the decline of specific activity of phospholipids of the brain and liver have taken place and remained so until the end of the experiment. During external γ irradiation the changes of the quantity and metabolism of phospholipids were less pronounced and were observed only on the 12th month of effect. (auth)

23547 EFFECT OF ULTRAVIOLET IRRADIATION AND VITAMIN D_2 ON THE CONCENTRATION AND EXTRACTION OF STRONTIUM-90 DUE TO CHRONIC ADMINISTRATION IN ANIMAL BODY. Mirzoyan, A. A. Vop. Radiobiol., Sb. Tr.; 6: 181-187 (1967). (In Russian)

Investigations have been carried out on 420 white male rats under the effect of ultraviolet rays and vitamin D-2. It became clear that ultraviolet rays (daily doses 420 microcuries per min/cm^2) and vitamin D-2 (200 i. u.) have a significant effect on the metabolism of strontium-90 in the body. In the early periods of the effect, this is expressed by more intensive metabolism on strontium-90 in the bone tissue. However, the effect of vitamin D-2 on the metabolism of strontium-90 is less. At the same time the experiments have shown that the speed of extraction of strontium-90 varies only in the first 30 to 60 days in irradiated and control groups of rats. In a later period the effective time of semi-extraction is identical in all the groups. (auth)

23548 FUNCTIONAL ACTIVITY OF THE ADRENAL GLAND UNDER THE COMBINED EFFECT OF X-IRRADIATION AND GALVANIC ANODIZING OF THE BRAIN. Vlasenko, S. P. Vop. Radiobiol., Sb. Tr.; 6: 221-225(1967). (In Russian)

The irradiation of brain tissue with direct current causes the rise of the functional activity of the hypophysis-adrenal gland system during irradiation with absolute lethal doses which is observed by the increase of the weight of the adrenal gland and by the decrease of cholesterol level. It seems quite possible that the duration of animal vitality depends on the stimulation of the adrenal gland. The latter plays a great role in the rise of the total resistance of the organism. (auth)

23549 CHANGE IN PLASMATIC CELLS DUE TO ACUTE IRRADIATION SICKNESS. Ogandzhanyan, E. E. Vop. Radiobiol., Sb. Tr.; 6: 233-239(1967). (In Russian)

Under total irradiation effect with a single dose of 600 rads, the plasmocytes are subjected to destructive changes in the lymphatic nodules of the black mice belonging to the C 57/6 strain. These changes are expressed by wrinkling of the nucleus, vacuolation, and the solution of the cytoplasm, as a result of which bare deformed nuclei remain. In the acute phase of radiation sickness destruction is seen in a large number of plasmocytes and the number of dead cells increases. Under the combined influence of estrogen and bone marrow transplantation the dead forms of plasmocytes appear in the nodules during the first 2 weeks. Their number subsequently decreases and at the time of recovery only a small number of plasmocytes are to be revealed. (auth)

23550 CHANGE IN FAT CELLS DURING ACUTE RADIATION SICKNESS. Ogandzhanyan, E. E. Vop. Radiobiol., Sb. Tr.; 6: 241-246(1967). (In Russian)

During total irradiation with a single dose of 600 rads, qualitative and quantitative changes of fat cells occur in the lymphatic nodules in grey mice belonging to the C 57/6 strain. In this period the number of fat cells increases and a mass of granules leaves the cells. At the same time with the development of acute radiation sickness we notice a decline in blood coagulation. During the combined influence of synestrol and bone marrow transplantation, after irradiation, beginning from the end of the 2nd week we notice a trend of normalization in the structure and quantity of fat cells and the time of blood coagulation, whereas in the experimental groups these changes increase. (auth)

23551 MORPHOLOGICAL CHANGES OF CERTAIN ORGANS AND SARCOMA-45 UNDER THE COMBINED EFFECT OF ANODIZING OF THE BRAIN AND LOCAL IRRADIATION OF TUMOR. Karagezyan, E. G.; Ogandzhanyan, E. E. Vop. Radiobiol., Sb. Tr.; 6: 247-255(1967). (In Russian)

Sarcoma-45 grafted under the skin caused marked changes in some organs. Lympho—and mielopoiesis sites decrease in the spleen. An acute decrease in the contents of RNA and DNA is noticed in the spleen, liver, and adrenal glands. The local irradiation of the tumor causes atrophic and dystrophic changes of the tumor cells, the increase of pathological mitosis in tumor cells, and some decrease of RNA level in tumor tissue. In the above mentioned cytological changes, a significant displacement does not take place from local irradiation of tumors in the spleen, liver, and adrenal glands due to grafted sarcoma-45. Local irradiation of the tumor together with brain anodizing stimulates not only the regrowth of the tumor but affects favorably the recovery of the histological structure of the spleen, liver, and adrenal glands. (auth)

23552 ELECTRONIC RISE OF BODY RESISTANCE DUE TO TUMOR GROWTH AND IONIZING RAYS. Arutynyan, R. K.; Ambartsumyan, S. G.; Gabrielyan, R. A.; Davtyan, R. A.; Tokhiyan, S. R.; Dadoyan, G. S. Vop. Radiobiol., Sb. Tr.; 6: 269-273(1967). (In Russian)

Data on irradiation injuries and tumor growth under the effect of the anodic pole of direct current are given. The authors proved that on the basis of the mechanism of antiblastic and antitumor effect of anodic current there exists the proficiency to strengthen the antiparabiotic and the physiological, natural nonelectrotonic state of the central nervous system. The latter in its turn stimulates the protective body potentiality to resist ultimate irradiation and tumor growth. (auth)

23553 COMBINED EFFECT OF DIRECT CURRENT, CHEMOTHERAPY AND IRRADIATION TREATMENT ON THE GROWTH OF SARCOMA-45 TUMOR. Gabrielyan, R. A. Vop. Radiobiol., Sb. Tr.; 6: 275-278(1967). (In Russian)

The results of experiments on 180 tumor-bearing rats revealed that the combined effect of antiparabiotic anodic direct current and half a therapeutic dose of sarcolysin has apparent antitumor results. An analogous picture is to be seen when direct current and x rays are applied together. It thus becomes clear that in conditions when good antitumor results have been obtained, the doses of antitumor drugs and x rays may be decreased. (auth)

23554 CHANGES OF THE STOMACH MOBILE FUNCTION IN CASE OF RADIATION SICKNESS DUE TO BLOODLETTING. Mikaelyan, M. G. Vop. Radiobiol., Sb. Tr.; 6: 289-294(1967). (In Russian)

Investigations were performed on 18 dogs with the Basov fistula. The dogs were divided into three groups. In the first group of dogs, bloodletting was performed (40 m.l./lkg.); the second group was irradiated while the third group was subjected to both. The dogs were irradiated with a RUM-11 apparatus. They were irradiated with 100 rads. In non-irradiated dogs bloodletting caused the weakening of mobile and evacuator function of the stomach; at the beginning of the 5th day of bloodletting gradual recovery is noticed. Complete recovery takes place only 10 to 15 days after bloodletting. Only irradiation at the initial period causes a strong depression of the mobile and evacuator function of the stomach which after 8 to 10 days becomes normal. Vigorous peristalsis, increase of rhythm and height of contraction, the lengthening of relaxation, slowness or rapidity of evacuation activity is to be noticed in some dogs. After the 20th day again we notice a second stronger depression of mobility and evacuation. After the combined influence of irradiation and severe bloodletting a stronger depression and an earlier symptom of normalizing of the stomach mobile function is noticed, but recovery does not take place. (auth)

23555 CHANGE OF HEART SENSITIVITY TOWARDS SOME CARDIAC DRUGS DURING RADIATION SICKNESS. Dovlatyan, S. V.; Melik-Israelyan, Sh. C. Vop. Radiobiol., Sb. Tr.; 6: 295-300(1967). (In Russian)

Experiments were carried out on the isolated heart of the frog by the method of Shtraube. Many series of experiments have shown that in irradiated frog the potential ability of muscle concentraction of the heart, isolated on the 7 to 8th day, declines. After a physical load the sensitivity of the heart noticeably rises due to drugs such as strophantin which immediately affects the heart muscle and such drugs as adrenalin, calcium chloride, proserine which affect heart activity on account of stimulation of termination of the sympathetic and parasympathetic nerve system in the irradiated animal. (auth)

23556 REACTION OF THE ISOLATED UTERUS OF THE IRRADIATED ORGANISM TO DRUGS. Dovlatyan, S. V.; Shmavonyan, E. T.; Martirosyan, E. S. Vop. Radiobiol., Sb. Tr.; 6: 301-307(1967). (In Russian)

Experiments were carried out on the isolated uterus of irradiated and non-irradiated rats and rabbits. The results have shown that depending on the period of irradiation the spontaneous contraction of the uterus noticeably changed. On the 7 to 8th day of irradiation tonic and rythmic intensification of contraction is to be observed whereas on the 17 to 18th day atonia of the uterus muscle is revealed. At the same time period the sensitivity of the uterus changes towards such drugs as pituitrin, ergotal, prenantol, and acetyl choline. On the 7 to 8th day of irradiation, under the effect of the above mentioned drugs, the reaction of the uterus is seen to be incomparably stronger, while on the 17 to 18th day a strong decline of uterus sensitivity is noticed towards the above mentioned drugs. (auth)

23557 CHANGES OF THE VALUE OF SKIN HISTAMINE, TREATED BY IRRADIATION AND HALVANIZATION. Yaralova, G. A.; Dadoyan, G. S. Vop. Radiobiol., Sb. Tr.; 6: 309-312 (1967). (In Russian)

Investigations were carried out on 55 white rats for histamine changes in skin before and after irradiation, separately anodizing and cathodizing, and simultaneously with the irradiation. The value of the histamine was investigated 15 minutes and 15 days after the treatments. The results showed that one of the mechanisms of the protective effect of anodic direct current is the initial and considerable reduction of histamine value after anodic treatment. Further restoration of histamine value occurs very slowly. (auth)

Invertebrates

Refer also to abstract 23580.

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 23304, 23470, 23471, 23477, and 23479.

23558 (CONF-740930-, pp 113-119) CHROMOSOME BREAKAGE IN LYMPHOCYTES FROM HUMANS WITH BODY BURDENS OF ^{226}Ra. Hoegerman, S. F.; Cummins, H. T.; Bronec, J. F. (Argonne National Lab., IL). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Peripheral lymphocytes from 10 controls and 40 patients with body burdens of ^{226}Ra ranging from below the limit of detection to 8.6 mu Ci were scored for unstable chromosome aberrations. The patient population was divided into four groups: a group with body burdens below the limit of detection (less than 0.003 mu Ci, 12 patients); a low-burden group (0.003 to 0.099 mu Ci, 13 patients); a moderate-burden group (0.1 to 0.99 mu Ci, 11 patients); and a high-burden group (greater than 1.0 mu Ci, 4 patients). In none of these groups was the frequency of cells with unstable aberrations significantly elevated above that in the controls. The rate of occurrence of dicentric and ring chromosomes was above the control frequency in only the two patients with the highest burdens (3.55 and 8.6 mu Ci). Our results are consistent with the expectation derived from a recent calculation of alpha dose delivered to blood by bone-deposited radium and its decay products. Marshall and Hoegerman have estimated that the blood dose for an individual with a radium burden of 1.0 mu Ci is 0.09 +- 0.03 rad/year. The value is compared with the dose estimate used by Boyd et al. in their study of British radium-dial painters, and the relevance of the blood dose to the lymphocyte dose is discussed. (auth)

23559 (CONF-740930-, pp 165-168) CELL-MEDIATED IMMUNITY AS AN EARLY DIAGNOSTIC TEST FOR OSTEOSARCOMA IN HUMAN RADIUM CASES. Lloyd, E. L.; Menon, M.; Mitchen, J. L. (Argonne National Lab., IL). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Lymphocytes from patients carrying a body burden greater than 0.3 mu Ci of ^{226}Ra have been tested for specific cytotoxicity to four different osteosarcoma cell lines as well as to normal human fibroblasts. Cytotoxicity indexes (defined as the ratio of the number of target cells remaining, after treatment with the patients' lymphocytes, relative to the values obtained with normal control subjects) have been calculated. With one exception no cytotoxicity was observed. This is in agreement with the fact that no fresh osteosarcomas were diagnosed. The patient in whom cytotoxicity was found was suffering from an inflammatory lesion involving bone as the result of a foreign-body reaction at the time of the first test. When the test was repeated 10 months later, no cytotoxicity was observed. No significant nonspecific cytotoxicity was observed when lymphocytes from normal control subjects were interacted with any of the target cell lines. (auth)

23560 (NIRS-14, pp 61-72) ENVIRONMENTAL STUDIES. Sep 1975.

In annual report, 1974.

Summaries are presented of research in the following areas: levels of Co, Cs, and Zn in some marine organisms in Japan; effects of tritiated water on the embryonic development of two marine teleosts; whole-body retention and tissue distribution of ^{144}Ce in beagles; estimation of the daily milk intake of the suckling rat using the turnover rate of potassium; effect of inert gas shielding on sensitivity for alkaline earth elements in atomic absorption spectroscopy using a fuel-rich nitrous oxide-acetylene flame; dispersion and accumulation of radiocobalt in the marine sediment of Urazoko Bay; ^{137}Cs contents in Japanese diet and estimation of the internal radiation doses from 1963 to 1971; concentration of radioactive cobalt by seaweed in food chain; chemical behavior of ^{144}Ce in estuarine water and offshore water; distribution of ^{65}Zn, ^{109}Cd, and ^{203}Hg in pregnant mice; and comparative study of absorption and excretion of ^{65}Zn, ^{109}Cd, and ^{203}Hg. (ERB)

Animals

Refer also to abstracts 23518, 23524, and 23595.

23561 (CEA-CONF-23120) EXPERIMENTAL STUDY ON THE TOXICITY OF SEVERAL RADIONUCLIDES INHALED AT

DIFFERENT DOSES. Lafuma, J.; Nenot, J. C.; Morin, M.; Masse, R.; Metivier, H.; Nolibe, D.; Skupinski, W. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 4p. (CONF- 750518-11). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

For over 5 years investigations were carried out on large lots of rats on the toxicological action of several inhaled radionuclides. In order to have varying residence times and spatial distributions in the lung, various physico chemical forms of α-emitting actinides and β-emitting lanthanides were used, respectively ^{239}Pu, ^{238}Pu, ^{241}Am, as oxide or nitrate solution at pH 1, ^{244}Cm nitrate, and ^{144}Ce chloride and ^{141}Ce chloride and oxide. The activities deposited per gram of lung varied between 10 nCi and 10 μCi. Data are presented on the incidence of lung neoplasms, fibrosis, pneumonitis, and immunological deficiency observed at various time intervals, and on the life span of the animals. (CH)

23562 (CONF-740930-, pp 83-89) INFLUENCE OF RADIATION-DOSE PATTERN FROM INHALED BETA-GAMMA-EMITTING RADIONUCLIDES ON CANINE PERIPHERAL LYMPHOCYTES. Jones, R. K.; Boecker, B. B.; Pickrell, J. A.; Hobbs, C. H.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

As part of studies to assess the biological hazards associated with inhaled radionuclides, periodic hematologic evaluations were performed on beagle dogs given a single nose-only exposure to aerosols of beta-gamma-emitting isotopes. The physical form and specific radionuclides selected produced radiation-dose patterns representative of those which might be encountered in the event of human accidental exposures. Dogs received graded lung burdens of either ^{90}Y, ^{91}Y, ^{144}Ce, or ^{90}Sr, each in fused clay. Differences in the effective half-lives of these radionuclides resulted in a spectrum of cumulative radiation doses to lung delivered at a variety of dose rates. Since the form in which the radionuclides were inhaled was relatively insoluble, the lung and intrathoracic tissues represented the primary recipient of the dose. Regardless of the effective half-life of radionuclide retention, a dose-related depression of peripheral lymphocytes was observed at various times after inhalation exposure. The time at which maximum depression and subsequent recovery occurred, however, was most directly related to the effective half-life of the radionuclide. Of special interest was the persistence of lymphopenia through 2½ years after exposure to ^{144}Ce and ^{90}Sr in fused clay where, other than tracheobronchial lymph nodes, the lymphoid tissue received very little radiation dose. The possible mechanisms responsible for lymphocyte depression from these various radiation-dose patterns are discussed. (auth)

23563 (CONF-740930-, pp 90-99) COMPARATIVE EFFECTS OF INHALED RELATIVELY INSOLUBLE FORMS OF ^{90}Y, ^{144}Ce, AND ^{90}Sr ON CANINE PERIPHERAL LYMPHOCYTE FUNCTION. Benjamin, S. A.; Jones, R. K.; Snipes, M. B.; Lustgarten, C. S. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D. C.).

Dogs that have inhaled relatively insoluble forms of either alpha- or beta-emitting radionuclides manifest a peripheral lymphopenia, the development and course of which depends on both total dose and dose rate. The remaining peripheral lymphocytes in dogs exposed to longer lived beta-emitting radionuclides showed a depressed function as measured by the ability to respond to plant mitogens in vitro. This experiment was designed to evaluate the effect of dose rate on peripheral lymphocyte function by exposing dogs to aerosols of radionuclides with varied effective half-lives in the lung: ^{90}Y (2.6 days), ^{144}Ce (170 days), and ^{90}Sr (650 days). Three groups of four adult beagle dogs each were exposed by inhalation to ^{90}Y, ^{144}Ce, or ^{90}Sr in fused-clay particles. Two controls were matched with each group. Initial lung burdens and initial dose rates to the lung were 520 to 610 mu Ci/kg of body weight and 2200 to 2600 rads/day in the ^{90}Y group, 33 to 60 mu Ci/kg and 200 to 350 rads/day in the ^{144}Ce group, and 25 to 32 mu Ci/kg and 130 to 170 rads/day in the ^{90}Sr group. Hematologic parameters and lymphocyte function as measured by the ability of lymphocytes to respond to plant mitogen stimulation were evaluated on a weekly or biweekly basis for 8 weeks after exposure and on a monthly basis thereafter. The ^{90}Y-exposed dogs showed a marked lymphopenia within 1 week with a return to control levels by 20 weeks after exposure. The remaining peripheral lymphocytes, however, showed no functional changes in these dogs. Animals exposed to ^{144}Ce or ^{90}Sr developed a progressive and persistent lymphopenia and showed functional depression of the remaining lymphocytes as well. The relationships among dose pattern, lymphopenia, and lymphocyte-function depression are discussed. (auth)

23564 (CONF-740930-, pp 100-105) LYMPHOCYTOPENIA INDUCED IN BEAGLE DOGS BY INHALATION OF $^{239}PuO_2$. Ragan, H. A.; Park, J. F.; Olson, R. J.; Buschbom, R. L. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

To determine the life-span dose-effect relationships of inhaled plutonium, we gave 124 beagle dogs a single exposure of $^{239}PuO_2$ 2 to 3 years ago at six different levels, i.e., 4, 20, 80, 300, 1100, or 5800 nCi mean initial alveolar depositions. Another group (20 dogs) served as controls. All dogs were about 18 months old. At the four highest exposure levels, a chronic lymphocytopenia developed which correlated with the initial alveolar plutonium burden in regard to magnitude of depression and time of development after exposure. The nadir occurred near 10 months after exposure in dogs receiving 5800, 1100, and 300 nCi, with corresponding lymphocyte levels 40, 55, and 75 percent, respectively, of those observed in control dogs. In the 80-nCi level the nadir occurred about 2 years after exposure at approximately 80 percent of control values. At the two lowest doses, i.e., 4 and 20 nCi, no effect on lymphocyte concentrations was noted 3 years after exposure. The persistent lymphocytopenia related to plutonium inhalation may be of significance in the subsequent development of pulmonary neoplasms previously observed in beagles at this laboratory 8 to 11 years after initial lung depositions of 200 to 1000 nCi of ^{239}Pu. (auth)

23565 (CONF-740930-, pp 106-112) CHROMOSOME ABERRATION FREQUENCY IN BLOOD LYMPHOCYTES OF ANIMALS WITH ^{239}Pu LUNG BURDENS. Brooks, A. L.; LaBauve, R. J.; McClellan, R. O.; Jensen, D. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Other investigators have suggested a causal relationship between accidental ^{239}Pu exposures in man and the presence of chromosome aberrations in blood lymphocytes. For experimental assessment of this relationship, 16 rhesus monkeys and 171 Chinese hamsters were exposed to $^{239}PuO_2$ aerosols and an additional five hamsters were injected with ^{239}Pu citrate, and the frequency of aberrations in blood lymphocytes was determined. Hamsters with the highest lung burden had a median survival time of about 80 days. No deaths occurred in any of the other treated hamsters or monkeys by 250 days after ^{239}Pu inhalation. Hamsters sacrificed at 30 days showed an increase in chromosome aberration frequency with increasing dose to lungs. By 120 days after inhalation, the aberration frequency in the controls was 0.012. The frequency in animals with doses that produced significant life shortening had decreased to 0.018 and to 0.032 aberration/cell in animals with lower doses. At 380 days after injection of 2 nCi of ^{239}Pu citrate per gram of body weight, hamster lymphocytes had an aberration frequency of 0.048 aberration/cell. The level of chromosome damage in the $^{239}PuO_2$-exposed monkeys at 30 and 90 days after inhalation was not different from that observed in controls. Possible reasons for differences between the experimental animal observations and findings in man are discussed. (auth)

23566 (CONF-740930-, pp 197-202) IN VITRO INTERACTIONS OF LYMPHOCYTES AND CULTURED CELLS FROM BEAGLES WITH PLUTONIUM-INDUCED BONE TUMORS. Frazier, M. E.; Lund, J. E.; Busch, R. H. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Cell cultures have been prepared from lung and bone tumors arising in beagle dogs following exposure to inhaled plutonium. Evaluation of the cultured cells by commonly applied criteria (i.e., cell morphology, lack of contact inhibitory mechanisms, cloning efficiency, growth in soft agar, and tumor production in vivo) indicated that tumor cells were being grown in culture. Blood

leukocytes and peripheral lymphocytes from beagle dogs were tested for cytotoxic effects against several cell cultures. Lymphocytes from normal dogs or dogs with unrelated tumors would not kill the bone tumor cells unless monocytes (macrophage) were present, in which case the leukocyte preparation was capable of mounting de novo cytotoxic immune reactions after 3 to 5 days in culture. In contrast, the dogs with plutonium-induced bone tumors had circulating lymphocytes that appeared to have undergone presensitization to bone-tumor-distinctive antigens in vivo. Consequently these lymphocytes interacted with cultured cells promptly after encounter in vitro. (auth)

23567 (CONF-740930-, pp 218-224) EFFECT OF ^{144}Ce INHALED IN FUSED-CLAY PARTICLES ON THE TRACHEOBRONCHIAL LYMPH NODES. Hahn, F. F.; Boecker, B. B.; Hobbs, C. H.; Jones, R. K.; Muggenburg, B. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Tracheobronchial lymph node changes and lymphopenia are sequelae of inhalation of relatively insoluble radioactive aerosols by beagle dogs. The tracheobronchial lymph nodes from dogs that inhaled ^{144}Ce in fused-clay particles were examined at intervals from 2 to 730 days after exposure to assess the development of these lesions. Initial lung burdens in the dogs studied ranged from 33 to 63 mu Ci/kg of body weight. The concentration of radioisotope in the tracheobronchial lymph nodes increased during the first year after exposure and exceeded that in the lung about 100 days after exposure. Autoradiographs of the lymph nodes showed that ^{144}Ce particles were present in macrophages in the paracortical zone two days after exposure and that concentrations continued to increase in the paracortical zone and medullary cords. Histologic changes in the nodes included atrophy of the germinal centers and lymphocytic follicles, loss of lymphocytes and accumulation of macrophages in the paracortical zone, accumulation of pigment and isotope-laden macrophages in the medullary cords, occasional infiltrates of neutrophils in the medullary cords, and at later time periods focal fibrosis of the medullary cords. Tracheobronchial lymph node weights of the dogs exposed to ^{144}Ce in fused clay were not decreased until 512 days after exposure. These findings indicate that tracheobronchial lymph nodes accumulate relatively high burdens of ^{144}Ce after ^{144}Ce is inhaled in a relatively insoluble form and that the pathologic changes resulting from these burdens are basically atrophy of the nodes. Primary neoplasms in lymph nodes were not observed in dogs with initial lung burdens of 0.0024 to more than 30 mu Ci/kg of body weight followed for up to 2000 days after exposure. At the higher levels, however, a high incidence of primary pulmonary neoplasia was observed. (auth)

23568 (CONF-740930-, pp 225-229) EFFECTS OF TRANSURANICS ON PULMONARY LYMPH NODES OF RODENTS. Sanders, C. L. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D. C.).

Pulmonary lymph nodes have been suggested as the "critical" tissue for insoluble, inhaled transuranic compounds owing to the high concentration of transuranics in these lymph nodes. About 800 rats were given from 0.2 to 3600 nCi of $^{238}PuO_2$ or $^{239}PuO_2$ by inhalation, intratracheal instillation, intrapleural injection, or intraperitoneal injection. From about 1 to 10 percent of deposited plutonium was translocated to pulmonary lymph nodes, the amount depending on the time after deposition and the route of administration; $^{238}PuO_2$ was cleared from pulmonary lymph nodes faster than $^{239}PuO_2$ owing to the greater in vivo solubility of $^{238}PuO_2$. No primary tumors of pulmonary lymph nodes were observed, indicating that this tissue was not the critical tissue for carcinogenic induction. (auth)

23569 (CONF-740930-, pp 239-245) PLUTONIUM-INDUCED LYMPHADENITIS IN BEAGLES. Dagle, G. E.; Park, J. F. (Battelle Pacific Northwest Labs., Richland, WA). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D. C.).

Plutonium oxide particles accumulate in the tracheobronchial lymph nodes of beagles exposed by inhalation and in the popliteal lymph nodes after subcutaneous injection in the hind paws. The sequence of histopathologic changes after phagocytosis of particles included necrosis, increased numbers of macrophages, and fibroplasia. Scar tissue eventually replaced the normal architecture of the lymph nodes and sequestered the plutonium particles from surrounding parenchyma. Electron microscopy showed that plutonium particles were aggregated in phagolysosomes of macrophages. (auth)

23570 (UCD-472-122, pp 112-117) CLINICAL STATUS AND PHILOSOPHY OF CLINICAL CARE OF RADIONUCLIDE-TREATED BEAGLES. MacMillan, K.; Holbrook, C.; White, R.; Chrisp, C. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

A manual for therapy of beagles is reviewed. The following protocol is outlined and described: antibiotic therapy, chemotherapy for neoplasms, hormone therapy, nutritional therapy, radiation therapy, steroid therapy, and miscellaneous treatments. The manual also includes sections on diagnosis and discussions of individual cases. Tables summarizing clinical cases seen during 1974 are presented. (HLW)

23571 (UCD-472-122, pp 118-127) CUMULATIVE MORTALITY IN RADIONUCLIDE-TREATED BEAGLES. Chrisp, C. E.; Pool, R. R.; Goldman, M.; Rosenblatt, L. S. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Sixteen beagles treated with ^{226}Ra died during the past year. Osteosarcomas caused the death of nine and six beagles in the R30 and R20 levels, respectively. Only one other beagle in the ^{226}Ra injection series died during the past year, an R05 dog with severe chronic active interstitial pneumonia. The cumulative survival rate of R20 beagles is significantly lower than that of controls. (auth)

23572 (UCD-472-122, pp 128-129) DISTRIBUTION OF ^{226}Ra-INDUCED PRIMARY BONE SARCOMAS IN BEAGLES. Pool, R. R.; Williams, R. J. R. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

The distribution of ^{226}Ra-induced bone sarcomas in beagles is discussed. Diagrams of skeletons are presented to show distribution of tumors in the axial and appendicular bones. (HLW)

23573 (UCD-472-122, pp 132-134) G-BANDING TECHNIQUE USEFUL IN THE CHROMOSOMAL ANALYSIS IN THE DOG. Whaley, C.; Taylor, N.; Sargent, A.; Wolf, H. G. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Advantages of the G-banding technique for chromosomal analysis are discussed and the technique is described. A table is presented to show chromosomal counts on radioinduced osteosarcomas in ^{226}Ra- and ^{90}Sr-treated beagles and representative photographs of banded chromosomes are shown. (HLW)

23574 (UCD-472-122, pp 135) IN VITRO ASSAYS FOR CELL-MEDIATED IMMUNITY IN DOGS WITH RADIATION-INDUCED OSTEOSARCOMA. Shifrine, M.; Taylor, N. J.; DeRock, E. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

The Radiobiology Laboratory experimental study on ^{226}Ra toxicity provides a model for the study of immune response in high-risk dogs and dogs with radiation-induced osteosarcoma. Studies were undertaken to measure both general immune response and specific immune response of dogs following amputation of the tumor-bearing limb using autochthonous cultured tumors. The cell-mediated immune competence (CMI) of dogs as measured by degree of stimulation of purified lymphocytes with phytohemagglutinin (PHA) has been determined in five available amputated dogs. The stimulation index was computed as the net ratio of ^{3}H-thymidine incorporation in stimulated vs unstimulated cells. (auth)

23575 (UCD-472-122, pp 136) IN VITRO CULTIVATION OF CANINE OSTEOSARCOMA. Shifrine, M.; Taylor, N. J.; Holloway, G. L.; DeRock, E. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Radioinduced osteosarcomas were grown in tissue culture; this provides a source of tumor-specific antigen for assaying antibodies directed against the osteosarcoma. Studies were conducted on cell-mediated immunity of ^{226}Ra-exposed dogs and the correlation of the immune response with radioinduced osteogenesis. (HLW)

23576 (UCD-472-122, pp 141-145) STUDIES ON MACROPHAGE ACTIVATION. Buhles, W. C.; Shifrine, M. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Investigations were undertaken to study application of macrophage system manipulation for protection of neutropenic animals from bacterial infections following irradiation or cytotoxic drugs and to evaluate the effects of irradiation and cytotoxic drugs on macrophages. These experiments are based on the premise that activation of the macrophage system prior to induction of neutropenia will decrease the risk of subsequent bacterial infections. To these ends, we have developed a murine model of overwhelming gram-negative rod bacteremia in neutropenic animals, tested various modes of activating macrophages, and applied these methods in the study of protection of neutropenic animals from infections. Neutropenia was induced by use of cytotoxic drugs. Preliminary study showed that Cytoxan (cyclophosphamide, CY) administered to mice causes a profound neutropenia. (auth)

23577 (UCD-472-122, pp 160-162) CHEMICAL ANALYSIS AND QUANTITATION OF THE TAPETUM LUCIDUM. Gee, N. A.; Fisher, G. L.; Nash, C. P. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

A study was conducted to provide a basis for the evaluation of the biochemical nature of the ^{226}Ra alterations of the beagle tapetum. Results indicated that zinc and/or melanin determinations in the tapetum nigrum and tapetum lucidum may allow quantitation of tapetum lucidum tissue without the need for physical separation of the tapetal layers. (HLW)

23578 BIOCHEMICAL AND MORPHOLOGICAL CHANGES DUE TO PROLONGED ADMINISTRATION OF ^{144}Ce IN RATS. Zapol'skaya, N. A.; Fedorova, A. V.; Lavrent'ev, L. N.; Grigoryan, Kh. V.; Smoroditseva, G. I.; Yakovleva, N. G.; Chulkova, O. N.; Mamedov, D. M.; Shagoyan, A. G. Vop. Radiobiol., Sb. Tr.; 6: 189-195(1967). (In Russian).

Experiments were carried out on 300 white male rats. Cerium-144 was administered in the form of chloride solution (1,6 microcurie activity) into the gastro-intestinal tract of the first group. The second group of rats received Ce. 0,16 m.c.q. The third group served as a control group. Investigations were made to determine the general condition of the animal, the weight, the quantitative and qualitative contents of formed elements of blood, as well as the functional condition of the adrenal gland and certain biochemical and pathomorphological data. The results of the experiments have shown that, in the period of 180 days, a marked decrease of thrombocyte number and the degeneration of leucocytes have taken place. A certain but short stimulation of the function of the cortical part of the adrenal gland has been observed. The biological and pathomorphological changes are of wave character. The above mentioned phenomena gradually decreased after cessation of isotope introduction. (auth)

23579 TUMORS DUE TO INTRODUCTION OF CHEMICAL CARCINOGENS ON THE BACKGROUND OF CHRONIC EFFECT OF RADIOACTIVE SUBSTANCES. Zapol'skaya, N. A.; Lavrent'ev, L. N.; Mamendov, D. M.; Pavlitskaya, E. D.; Fedorova, A. V.; Chulkova, O. N.; Mirzoyan, A. A. Vop. Radiobiol., Sb. Tr.; 6: 197-201(1967). (In Russian)

Experiments were carried out on white rats subjected to strontium−90 and the chemical carcinogen (9,10 dimethyl−1,2 benzantracen). It was revealed that the chronic introduction (7 or 10 months) of strontium−90 in concentrations of 2.10^{-4} microcurie a day insignificantly affects the frequency of tumors induced by chemical carcinogens. At the same time preliminary introduction of strontium−90 in doses 8.10^{-3} micro-curie and later combined with the injection of the carcinogen decreases the threshold dose of blastomogen effect of carcinogen. (auth)

Microorganisms

Refer also to abstract 23371.

23580 (AECL-5309, pp 59-73) BIOLOGY BRANCH. Balwin, W. F. Nov 1975.

In Biology and Health Physics Division progress report, July 1−September 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.).

Research on the effects of radiation and repair from radiation damage in different organisms has continued. Experiments on the sensitivity of cells of Micrococcus radiodurans to ^{125}I disintegrations in their DNA showed that the radiation produces double strand breaks in the DNA with high efficiencies, and a wild type and two mutant strains, which are highly sensitive to γ radiation, seem to repair these breaks rapidly and efficiently. Studies of the release of polysaccharide from the cell wall of M. radiodurans following ionizing radiation are directed toward the investigation of the mechanism whereby hydroxyl radicals damage the sensitive mid wall layer and allow the release of its constituents. In the wasp Dahlbominus studies of the effects of heat during irradiation showed very high frequencies of eye color mutants. The occurrence of malformations in these experiments shows a corresponding decrease with increasing intervals between heat and irradiation. (CH)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 22843 and 23610.

23581 (CONF-740930-, pp 54-58) STUDIES OF PLUTONIUM IN HUMAN TRACHEOBRONCHIAL LYMPH NODES. McInroy, J. F.; Stewart, M. W.; Moss, W. D. (Los Alamos Scientific Lab., NM). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Since 1959, tissues from 70 occupationally exposed former employees of the Los Alamos Scientific Laboratory have been examined following autopsy. Exposure in most cases was to inhaled plutonium oxide aerosols. Chemical analyses of selected tissues were performed to determine the amount of plutonium retained in the body at the time of death. On the basis of the measured tissue concentrations of plutonium, extrapolations of total-body burdens were made. Thirty-three of the measured cases had plutonium depositions in the tracheobronchial lymph nodes ranging from 0,1 to 4000 dpm per gram of tissue (0,05 to 1800 pCi/g). The duration of exposures ranged from 4 to 30 years. Microscopic examination of representative sections of these lymph nodes revealed no abnormalities other than those which were directly attributable to the basic disease that caused the demise of the various persons in this study. The size distribution of plutonium particles in nodes from one individual was determined by exposing tissue sections to nuclear track film. The estimated mass median diameter of the particles was 0,3 mu m, and the distribution had a geometric standard deviation of 1,6. It is estimated that 95 percent of the individual particles had corresponding plutonium concentrations between 0,001 and 0,22 pCi. (auth)

23582 (CONF-740930-, pp 67-72) UPTAKE KINETICS OF RELATIVELY INSOLUBLE PARTICLES BY TRACHEOBRONCHIAL LYMPH NODES. Thomas, R. G. (Los Alamos Scientific Lab., NM). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Tracheobronchial lymph nodes accumulate a portion of material deposited in the deep lung following inhalation of relatively insoluble particles. Experiments involving a variety of compounds, inhaled singly or repeatedly, indicate that the kinetics of lymph node uptake are fairly independent of particle characteristics and mammalian species. The buildup per unit weight of nodal tissue compared with that of lung tissue, with time, can be represented by a linear logarithmic function. However, since the scatter in experimental points may be large at any given time after inhalation exposure, a number of different kinetic descriptions of uptake can be derived. The logarithmic pattern of accumulation can be approximated over an extended time range (several years) by use of a combination of first-order kinetics of loss from the lung and of buildup in lymph nodes, but it is recognized that the processes are much more complicated than this treatment would indicate. Clearance (loss) from the lymph nodes is not well defined, but this aspect is discussed in light of the kinetic models presented. (auth)

23583 (FRNC-CONF−129) DTPA THERAPY OF LUNG CONTAMINATIONS: TESTING A SELF CONTAINED AEROSOL GENERATOR. Ducousso, R.; Pasquier, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1975. 3p. (CONF-750518−8). Dep. NTIS (US Sales Only) $3.50.

From third European IRPA congress; Amsterdam, Netherlands (13 May 1975).

Much of the effectiveness of DTPA therapy of respiratory contamination by radioactive aerosols decreased when the delay of administration of the product increased. An individual pocket apparatus allowing emergency DTPA inhalation on the spot of the accident was tested using DTPA powder inhaled by a volunteer previously contaminated by a $^{140}La\ Cl_3$ aerosol. Micronized powder of monocalcic and trisodic DTPA was used (80% of the particles had a diameter under 2 μm). The powder was available in 50 mg capsules. Because the lung burden following a respiratory contamination is unknown at the time of the emergency therapy, no dosage can be prescribed. The interpretation

of the above results indicates that following an accident, it should be wise to recommend the inhalation of the content of 5 capsules. (CH)

23584 PLUTONIUM AND TRANSPLUTONIAN BIOLOGY. Lafuma, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section de Pathologie et Toxicologie Experimentale). Rev. Gen. Nucl.; 1: No. 2, 119-122(Apr 1975). (In French)

The present state of knowledge in the field of plutonium and transplutonian biology is reviewed. The physico-chemical properties of these substances, the conditions in which they can contaminate human beings, their behavior on mammals, their toxic effects and the correlative contamination treatment technique are analyzed successively. Plutonium and transplutonians, although relatively toxic, have as yet never caused severe injuries to humans. They cannot be transmitted to man through alimentary chains and constitute a hazard only for those who handle them. In this last case, the existing protection techniques offer such a high degree of efficiency that virtually all risk of contamination is eliminated. (FR)

23585 CALIBRATION AND MEASUREMENT OF POTASSIUM-40 WITH A WHOLE-BODY COUNTER. Van Reenen, O. R.; Loetter, M. G.; Minnaar, P. C. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Biophysics); Iturralde, M. (University of the Orange Free State, Bloemfontein (South Africa). Dept. of Internal Medicine). S. Afr. Med. J.; 48: 2482-2485(7 Dec 1974).

Total potassium content in the human body may be obtained by measuring naturally occurring radioactive potassium-40, in a whole-body counter. The basic problem in calibrating the whole-body counter is discussed, as well as a phantom that is used to solve this problem. The normal potassium levels for men and for women were determined. Two additional parameters, lean body mass and total body water, derived from the potassium content, were also calculated. (INIS)

Animals

Refer also to abstracts 23274, 23506, and 23560.

23586 (AAEC/E-340) SYNERGIC FACTORS IN MURINE NEPHROSIS, DEMONSTRATED BY COMPUTER TECHNIQUES. Tucker, A. D.; Ehmen, G.; Smith, H. E.; Barry, J. M.; Bills, J. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1975. 21p. Dep. NTIS (US Sales Only) $3.50.

Simple environmental changes, including a whole, fresh diet, delayed the onset of the usual diseases of lungs and kidneys in laboratory rats. Spontaneous nephrosis appears to develop from interactions involving inherent immune status, nurture, and environmental factors, particularly inhalants. These methods could be adapted to toxicological investigations and the results suggest the need for new approaches in statistical and interpretative analyses. (auth)

23587 (CONF-740930-, pp 2-9) STUDIES OF PLUTONIUM AND THE LYMPHATIC SYSTEM: SIX YEARS OF PROGRESS AT COLORADO STATE UNIVERSITY. Lebel, J. L.; Bistline, R. W.; Schallberger, J. A.; Dagle, G. E.; Gomez, L. S. (Colorado State Univ., Fort Collins). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

Air-oxidized PuO_2, high-fired (850°C) PuO_2, $Pu(NO_3)_4$, PuF_4, and $PuCl_3$, all of which had known amounts of ^{241}Am, were implanted over the left metacarpus of beagles. The concentration of plutonium and ^{241}Am in various tissues was measured as a function of time. The effect of diethylenetriaminepentaacetate (DTPA) therapy on organ deposition was studied. Significant differences in the translocation dynamics of air-oxidized PuO_2, high-fired PuO_2, and $Pu(NO_3)_4$ in the left superficial cervical lymph node (LSCLN) were observed by in vivo measurement and radiochemical analysis. At the implant site 1 year postimplant, a 70 percent reduction in activity was observed with $Pu(NO_3)_4$, a 90 percent reduction with PuO_2 (high fired), and only a 20 percent reduction with air-oxidized PuO_2. The effect of larger particle size on the movement of plutonium from a wound site was speculated. Chemical form and physical form appear to change the rate of translocation and relative depositions of plutonium and americium in various organs. Particle size was not found to be an important factor in the total movement of plutonium in afferent and efferent lymph. More plutonium moves in the cellular fraction of afferent and efferent lymph regardless of particle size. The clearance of plutonium particles from the lymph nodes was associated with necrosis of macrophages. The effect of DTPA therapy on plutonium concentration was greater for the nitrate than for the other chemical forms. (auth)

23588 (CONF-740930-, pp 10-18) TRANSLOCATION DYNAMICS OF $Pu(NO_3)_4$ AND PuO_2 FROM PUNCTURE WOUNDS TO LYMPH NODES AND MAJOR ORGANS OF BEAGLES. Bistline, R. W.; Lebel, J. L.; Dagle, G. E. (Colorado State Univ., Fort Collins). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The translocation dynamics of plutonium and americium from simulated puncture wounds in the paws of beagle dogs following contamination with $Pu(NO_3)_4$ and high-fired PuO_2 was studied. Fractions of initial implant transported to the first major lymph node and to major body organs were measured with in vivo counting equipment and by radiochemical analysis of tissue material collected at necropsy. Samples were obtained from serial necropsies ranging from 2 weeks to 1 year after implant. The difference in lymph node and organ-accumulation dynamics between the two chemical forms and the effects of diethylenetriaminepentaacetate (DTPA) chelation treatment are presented. Active mechanisms to transport plutonium to and from the lymph system appear to exist. Equations for buildup in the lymph nodes and organs are included. The data suggest a buildup in the lymph node to a maximum, followed by a long negative slope, and a possible dose-rate effect from $Pu(NO_3)_4$ in lymph nodes. (auth)

23589 (CONF-740930-, pp 19-27) LYMPH TRANSPORT OF SOLUBLE AND INSOLUBLE PLUTONIUM. Schallberger, J. A.; Dewhirst, M. W.; Lebel, J. L. (Colorado State Univ., Fort Collins). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

The uptake and transport mechanisms of soluble [$Pu(NO_3)_4$] and insoluble (polydispersed PuO_2) plutonium were studied in afferent and efferent lymph from the popliteal lymph nodes of dogs after simulated-wound exposures. Lymph was partitioned into acellular and cellular fractions. Plutonium nitrate concentration was higher in the acellular fraction of both afferent lymph and efferent lymph than in the cellular fraction, whereas the polydispersed PuO_2 concentration was higher in the cellular fraction at the end of the collection period. Discontinuous-gel, isoelectric-focusing-gel, and cellulose acetate strip electrophoresis indicated that transferrin and albumin were the two principal proteins transporting plutonium in the acellular fraction of both afferent and efferent lymph. (auth)

23590 (CONF-740930-, pp 46-53) UPTAKE AND RETENTION OF INSUFFLATED TANTALUM BY LYMPH NODES. Kilpper, R. W.; Bianco, A.; Gibb, F. R.; Landman, S.; Morrow, P. E. (Univ. of Rochester, NY). 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

A nonsacrifice, radiographic technique is presented for evaluating the lymph node uptake of radiographically dense materials from the lungs of beagle dogs into which the material was insufflated. With tantalum as the contrast agent, lymph nodes sometimes become visible within 2 days after exposure when the insufflation resulted in radiographic "alveolarization" of some of the tantalum. Localization of the material within the nodes was observed in subsequent radiographs as well as persistent retention after as much as 1 year. Through the use of preinsufflation control films and tantalum foils of varying thickness, densitometric methods for determining the amount of tantalum within the lymph nodes are being investigated. Tantalum-182 is being used to follow the lung retention of the material as well as to verify estimates of burdens in harvested nodes. Preliminary lymphokinetic data are presented from experiments utilizing powders of 1 and 5 mu m (mean) particle sizes. (auth)

23591 (CONF-740930-, pp 59-66) IN VIVO DETECTION OF PLUTONIUM IN THE TRACHEOBRONCHIAL LYMPH NODES WITH A FIBER-OPTIC COUPLED SCINTILLATOR. Swinth, K. L. (Battelle Pacific Northwest Labs., Richland, WA); Park, J. F.; Voelz, G. L.; Ewins, J. H. 1976.

From 14th Hanford biology symposium on radiation and the lymphatic system; Richland, Washington, USA (30 Sep 1974).

In radiation and the lymphatic system. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); USAEC Division of Biomedical and Environmental Research, Washington, D.C.).

An intraesophageal probe was developed for measuring plutonium in the tracheobronchial lymph nodes. The probe uses a fiber-optic coupled NaI(Tl) scintillator as a detector and has a detection limit one-tenth that of a solid-state probe previously used for this measurement. The probe, with a projected sensitivity of 1 cpm/nCi, was used to detect plutonium in the lymph nodes of 11 experimentally exposed dogs. Tests on an accidentally exposed human volunteer yielded positive counts from the lymph nodes from an amount estimated at 7 nCi in the tracheobronchial lymph nodes. (auth)

23592 (UCD-472-122, pp 30-31) ^{131}I UPTAKE IN NEWBORN BEAGLES. Book, S. A. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Tracer studies with pups less than 36 hr of age showed an average peak ^{131}I uptake of 14.4 percent (128 percent/g), and a T/sub E/ of approximately 4.4 days. The estimated dose to the thyroid gland was about 90 rads per mu Ci administered vs. approximately 11 rads per mu Ci for the adult. (auth)

23593 (UCD-472-122, pp 32-38) THYROIDAL UPTAKE AND RETENTION OF ^{131}I BY PREGNANT AND FETAL GUINEA PIGS. Book, S. A.; McNeill, D. A. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Preliminary studies on thyroidal ^{131}I concentration by fetal guinea pigs indicate a peak uptake approximately 7 times that of the maternal gland, with an effective half-life of less than 2 days. The resultant dose was estimated to be 37 rads for the maternal gland and from 60 to 81 rads for the fetal gland per microcurie administered. From 1 to 11 days after maternal injection of ^{131}I, amniotic fluid contained more ^{131}I per liter than did fetal blood which in turn had a greater concentration than did maternal blood. (auth)

23594 (UCD-472-122, pp 44-49) BONE AND MARROW SPACES OF BEAGLE SKELETONS IN DOSIMETRY OF ^{90}Sr AND ^{226}Ra. Momeni, M. H. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Humeral surface and volume and trabecular thickness were measured by a coupled microscope-computer system. Implications of the bone space dimensions on local ^{90}Sr–^{90}Y and ^{226}Ra dose to osteogenic and erythrogenic elements are discussed. Microradiographs are shown of transverse and sagittal sections of the beagle humerus. (HLW)

23595 (UCD-472-122, pp 50) DOSE RATES, DOSE AND AGE EFFECTS OF ^{90}Sr–^{90}Y AND ^{226}Ra BODY BURDEN ON RADIATION-INDUCED SKELETAL INJURY, PRIMARY BONE SARCOMAS AND MORTALITY IN BEAGLES. Momeni, M. H.; Williams, J. R.; Jow, N.; Rosenblatt, L. S. Jun 1975.

In annaul report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Radiation-induced skeletal injury (E), primary bone sarcomas (PBS) and lifespan shortening (DELTA) were studied in Beagles fed $^{90}SrCl_2$ for 1.5 years or administered ^{226}Ra Cl (iv) over four months starting at 2, 4, or 14 months of age. Lifespan shortening was compared with that caused by a single injection of ^{90}Sr or ^{226}Ra or by inhalation of $^{90}SrCl_2$. Skeletal changes were assessed by a radiographic x-ray score. Bone changes in ^{90}Sr or ^{226}Ra labeled humeri were compared with skeletal scores. Skeletal changes classified included endosteal and/or periosteal cortical sclerosis and thickening (ECST, POCST), fractures, osteolytic lesions, and trabecular coarsening. ECST incidence was 100 percent in at least one site in dogs receiving greater than 9.3 mu Ci ^{226}Ra and POCST incidence was 100 percent only at greater than or equal to 83.6 mu Ci ^{226}Ra. At 0.53 mu Ci ^{226}Ra, ECST and POCST incidence were both 5 percent. Fractures were observed at 14 mu Ci ^{226}Ra and were 50 percent and 100 percent at 28.1 mu Ci ^{226}Ra and 83.6 mu Ci, respectively. (auth)

23596 (UCD-472-122, pp 90-101) RETENTION AND DISTRIBUTION OF ^{226}Ra IN BEAGLES: A COMPARISON BETWEEN MULTIPLE AND SINGLE INJECTIONS. Momeni, M. H.; Rosenblatt, L. S.; Jow, N.; Dunford, P.; Soo, S.; Coffelt, S. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Skeletal uptake, retention, and distribution of ^{226}Ra were studied in 330 beagles administered eight semi-monthly i.v. injections of radium starting at 2, 4, and 14 months of age. Skeletal uptake, the ratio of body burden at 35 days post-injection (A_{35}) to the total injected dose (A_0) was 71.7 percent, 78.1 percent and 38.5 percent, for a dose of 10 mu Ci/kg body weight administered starting at 2, 4, and 14 months of age, respectively. Skeletal retention of radium 350 days post-injection (A_{350}/A_0) was 67.2 percent, 73.3 percent, and 27.7 percent. Comparison of ^{226}Ra retention from single and multiple injections of radium shows that at dose level 6.064 mu Ci/kg the retention functions for periods 35 days after injection are identical; for dose level 10 mu Ci/kg, a larger retention is observed for multiple-injection groups. Comparison of ^{226}Ra retention in man with that in beagles shows that within a period between 35 days and 6000 days post-injection, the body burden in dog decreases by about 6 times in contrast with 43 times in man. Regional distribution of ^{226}Ra in bone matrix at proximal, midshaft, and distal humeri from 21 beagles shows the highest concentration of the radionuclide at proximal regions. Radium distribution on autoradiograms shows a uniform distribution in 4-month-old beagles in contrast to "hot spots" superimposed on a diffuse background for the 14-month age group. Radium in the latter group is located mostly on periosteum and endosteum surfaces. (auth)

23597 (UCD-472-122, pp 102-108) DISTRIBUTION OF ^{90}Sr–^{90}Y DOSE INJECTED INTO OR INGESTED BY BEAGLES. Momeni, M. H.; Jow, N.; Bradley, E. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Tables and graphs are presented to show the following data after injection or ingestion of ^{90}Sr–^{90}Y: average body weight and growth rate; skeletal growth pattern; ratio of dry humerus weight to dry skeletal weight; ^{90}Sr–^{90}Y concentration and dose rate measured by thermoluminescent dosimetry for three bone regions; retention parameters for ^{90}Sr–^{90}Y ingestion; dose rates to bone marrow; local dose rate and ^{90}Sr–^{90}Y concentration at depicted regions of third lumbar vertebra; average dose rate to skeletons of male and female beagles; and body burden retention normalized to ^{90}Sr–^{90}Y injection dose. (HLW)

23598 LOCALIZATION OF CALCIUM IN THE ACELLULAR BONE TISSUES OF THE MULLET (MUGIL AURATUS RISSO). Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Ann. Inst. Oceanogr.; 51: No. 1, 77-81(1975). (In French)

Using film autoradiographs a preferential distribution of ^{45}Ca was noticed on the surface of different bone formations (vertebrae, gills, operculum, fins and dorsal spines) of the Mullet, which are probably sites of bone formation or remodelling. (FR)

23599 METABOLISM OF STRONTIUM AND CALCIUM IN BONE TISSUE. Borisova, V. V.; Zapol'skya, N. A.; Mirzoyan, A. A. Vop. Radiobiol., Sb. Tr.; 6: 203-207(1967). (In Russian)

The distribution and extraction of strontium 90 and calcium 45 from different skeleton bones during simultaneous oral administration in white male rats were studied. Experiments have shown that the highest specific activity was in the skull and gradually decreased in the bones of the pelvis, limbs, ribs, spine, and the breast bone. At the same time it became clear that during the first 3 months 60% of strontium and 25% of calcium of the accumulated amount in the body have been excreted. The difference of the biological excreted constants of strontium and calcium is probably due to deeper penetration of calcium in the crystal reticulum of the bone tissue. (auth)

23600 ACCUMULATION OF STRONTIUM-90 IN THE SKELETON OF RATS DUE TO PRELIMINARY ULTRAVIOLET IRRADIATION AND ITS DISTRIBUTION IN BONE TISSUE. Mirzoyan, A. A. Vop. Radiobiol., Sb. Tr.; 6: 209-220(1967). (In Russian)

The effect of preliminary ultraviolet irradiation was studied on the metabolism and distribution of strontium−90 in various biochemical structures of the bone tissue in white male rats. The investigations have shown that preliminary ultraviolet irradiation of animals affects the intensity of strontium−90 metabolism in the bone tissue which is strongly expressed in preliminary irradiation lasting 30 days. The divisions of biochemical fractions of the bone tissue have shown that under ordinary conditions 76% of the accumulated strontium−90 are rapid metabolic fractions while 24% are arduous metabolic fractions. In case of irradiation with ultraviolet rays this proportion changes to 85% and 15% accordingly. The mathematical analysis of experimental data has shown that the process of accumulation and excretion of strontium−90 corresponds to the bicomponent exponential mathematical model during ordinary and additional ultraviolet irradiation. (auth)

23601 THE EARLY PHASES OF THE KINETICS OF PLUTONIUM 239 METABOLISM IN THE CHIEF ORGANS AND TISSUES OF DEPOSITION IN THE ANIMAL ORGANISM. Nechev, Kh. (Meditsinka Akademiya, Sofia (Bulgaria). Katedra po Medико-Sanitarna Zashtita). Acta Med. Bulg.; 2: No. 1, 41-49(1974).

A quantitative assessment of the early kinetic phases of the metabolism of ^{239}Pu is carried out. The radionuclide is introduced into rats a single time via i. v. injection in the form of

$PuCl_3$ at 0,6 μCi activity. Radionuclide content in organs and tissues is determined from 3 hours to 6 days after treatment. In the beginning (3 hours post treatment) ^{239}Pu is accumulated mainly in the liver whereas later (6 days post treatment) a redistribution takes place converting hepatic into skeletal pattern of distribution. Nevertheless the concentration of the radionuclide is higher in the liver in comparison with bones. Plutonium 239 is found to be almost completely bound to the tissue proteins in the liver, predominantly to the globulins (55%), during the first day. Later a certain redistribution of the radionuclide among the various protein fractions of the hepatic tissue was observed which can be interpreted as a matter of different turnover rate of ^{239}Pu bound to the different hepatic proteins. The effective period of half removal of ^{239}Pu from the liver is exponentially determined and amounts to approximately ten days; it is conditioned primarily by the period of the half removal of the complex compounds of the radionuclide from the hepatic globulins. In the bone tissue the kinetics of plutonium 239 metabolism is determined mainly by its complex compounds with the collagen and with the inorganic fraction. The complex compounds of the radioisotope with albuminoids and with other proteins, on account of their small quantities, exert no influence whatsoever on the pattern of the radionuclide metabolism in the bone. The correlation between the effective periods of half removal of ^{239}Pu from the organs and its removal from the respective complex compounds, formed with the tissue biostructures, is underlined. (INIS)

Plants

Refer also to abstract 23292.

23602 (NERC-LV-539-37) PLUTONIUM UPTAKE BY A SOIL MICROORGANISM, ASPERGILLUS NIGER. Au, F. H. F.; Beckert, W. F.; McFarlane, J. C. (Environmental Monitoring and Support Lab., Las Vegas, Nev. (USA)). Jan 1976. Contract AT(26-1)-539. 16p. Dep. NTIS $4.00.

A common soil fungus, Aspergillus niger, was grown on malt agar and in broth containing soluble Pu compounds. The transport factors derived from this series of experiments indicate that Pu was concentrated in the mycelium and further transported to the aerial spores of this fungus. A new and simple spore collection technique was developed to prevent cross-contamination of the spores with mycelial fragments and by direct contact with the Pu-containing agar medium. If a similar process occurs in plutonium-contaminated soils, it could be an important link in the transfer of soil-deposited plutonium to man. It would also explain the apparent time-dependent increases in the uptake rate of plutonium by plants grown on contaminated soils. (auth)

New Tracer Techniques

Refer also to abstracts 23468, 23486, and 23560.

23603 (CONF-7210137-) PROSTAGLANDINS IN FERTILITY CONTROL. Report from Meetings of the Prostaglandin Task Force Steering Committee. Bergstroem, S. (Ed.). (World Health Organization, Geneva (Switzerland); Kungliga Karolinska Mediko-Kirurgiska Institutet, Stockholm (Sweden)). 1973. 115p. (CONF-720237-; CONF-7206113-). Karolinska Institutet, Stockholm, Sweden.

A separate abstract was prepared for one paper concerning assay of prostaglandins in humans. (CH)

For an abstract of an individual paper see: 23604.

23604 (CONF-7210137-, pp 55-61) LITERATURE DATA ON ENDOGENOUS LEVELS OF PROSTAGLANDINS IN HUMANS MEASURED BY BIOASSAY, RADIOIMMUNOASSAY, AND GAS CHROMATOGRAPHY: MASS SPECTROMETRY. Green, K.; Grandstroem, E. (Karolinska Institutet, Stockholm). 1973.

From conference on analytical procedures, metabolism and clinical evaluation; Stockholm, Sweden (2 Oct 1972).

In prostaglandins in fertility control. Report from meetings of the Prostaglandin Task Force Steering Committee.

Literature data on endogenous levels of primary prostaglandins in peripheral venous blood as measured by radioimmunoassays range from non-detectable usually less than 100 to 200 picog/ml up to several nanog/ml. Mass spectrometric data indicate levels lower than 200 picog/ml. Metabolic and pharmacokinetic data strongly indicate that the basal endogenous levels of the primary prostaglandins in peripheral venous blood should be below 2 picog/ml. The reasons for the high values found in most studies are very likely combinations of 1) unspecific quantitation techniques, 2) sensitivity of the assays not high enough, 3) formation of primary prostaglandins during collection and handling of the blood. Therefore, it seems desirable to measure one of the initially formed metabolites instead (15-keto-13, 14-dihydro-PGE_2 of $PGF_{2\alpha}$), which during infusion is found in levels 10 to 75 times higher than that of the primary prostaglandin. With gas chromatographic–mass spectrometric technique the level of 15-keto-13, 14-dihydro-$PGF_{2\alpha}$ has been found to be about 25 picog/ml plasma. During the last few years data have appeared in the literature on endogenous levels of prostaglandins in peripheral human blood. The object of this article is to briefly review the published data. The methods that have mainly been employed for measuring endogenous blood levels of prostaglandins in humans are different types of radioimmunoassays and gas liquid chromatography–mass spectrometric techniques using deuterated carriers and either accelerating voltage alternating system or repetitive magnetic scanning. In a few studies blood levels have been estimated using a bioassay. (auth)

23605 (CONF-740701-, pp 301-320) RADIOISOTOPIC-EXCITED X-RAY FLUORESCENT SYSTEM FOR PPM MEASUREMENT OF TOXIC HEAVY METALS. Leddicotte, G. W.; Tolea, F.; Hansen, J. S. (Georgia Inst. of Tech., Atlanta). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

In agricultural research there is a continual awareness of the need to determine the role trace elements have as micronutrients in soil-plant systems. Similarly, these agronomic needs have a strong relationship to the concern other life sciences researchers have about the roles and effects of toxic trace elements on the natural environment and the physiological well-being of man and animals. However, in order for these interest areas to carry out more effective study efforts, more practical and precise analytical methodology and devices need to be developed. This report describes a research effort to develop an analytical system for micronutient as well as toxic elements based on x-ray fluorescence.

23606 (CONF-751027-8) CLINICAL $^{13}CO_2$ BREATH TESTS: METHODOLOGY AND LIMITATIONS. Schoeller, D. A.; Klein, P. D.; Schneider, J. F.; Solomons, N. W.; Watkins, J. B. (Argonne National Lab., Ill. (USA)). 1975. 15p. Dep. NTIS $3.50.

From 2nd international conference on stable isotopes; Oak Brook, Illinois, USA (20 Oct 1975).

Methods were developed to perform $^{13}CO_2$ breath tests and the limitations and sources of error in these tests were explored. The random error introduced during each step of the analysis was determined and it was found that the precision was limited by the fluctuations in the isotope ratio of the patient's endogenous CO_2. The detection limit was a 1.4 percent increase in the isotope ratio. This corresponds to an oxidation rate of 140 nmoles/kg-hr of singly labeled substrate to CO_2. The use of stable isotope ^{13}C provides a safe and sensitive alternative to the use of the radionuclide ^{14}C and extends the utility of CO_2 breath tests to the previously exempted populations of children and pregnant women. (auth)

23607 (CONF-751175-1) SOME THOUGHTS ON THE SELECTION OF SCREEN-FILM COMBINATIONS AND EVALUATION OF THEIR IMAGING PERFORMANCES. Doi, K.; Rossmann, K. (Chicago Univ., Ill. (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. Contract E(11-1)-69. 21p. Dep. NTIS $3.50.

From 1st image receptor conference on film-screen combination; Washington, District of Columbia, United States of America (USA) (13 Nov 1975).

In order to make an intelligent choice of a screen-film combination in diagnostic radiology, one must study the diagram relating physical image quality and diagnostic accuracy. Several methods for evaluation of the physical image quality are being developed; some results for three screen-film systems are presented. (auth)

23608 (CONF-760119-1) 14 IN. x 17 IN. FILM RECORDER FOR COMPUTER-ENHANCED SCANS. Morris, A. C. Jr.; Barclay, T. R.; Akin, T. E.; Hansard, M. C.; Gibbs, W. D.; Modzelewski, C. U. (Oak Ridge National Lab., Tenn. (USA)). 1976. 20p. Dep. NTIS $3.50.

From 6th symposium on the sharing of computer programs and technology in nuclear medicine; Atlanta, Georgia, United States of America (USA) (26 Jan 1976).

Physician acceptance of computer-enhanced radionuclide scan results, presented in the form of small Polaroid pictures, has been very limited for a number of subjective reasons. A new recorder was designed and constructed that presents the results of computer augmented scans through a medium that is quite familiar to doctors, the standard 14 in. x 17 in. x-ray film. (auth)

23609 (CONF-760119-3) NON-LINEAR IMAGE PROCESSING. Bell, P. R.; Dillon, R. S.; Bell, M. R. (Oak Ridge National Lab., Tenn. (USA)). 1976. 10p. Dep. NTIS $3.50.

From 6th symposium on the sharing of computer programs and technology in nuclear medicine; Atlanta, Georgia, United States of America (USA) (26 Jan 1976).

Processing of nuclear medicine images is generally performed by essentially linear methods with the non-negativity condition being applied as the only non-linear process. The various methods used: matrix methods in signal space and Fourier or Hadamard transforms in frequency or sequency space are essentially equivalent. Further improvement in images can be obtained by the use of inherently non-linear methods. The recent development of an approximation to a least-difference method (as opposed to a least-square method) has led to an appreciation of the effects of data bounding and to the development of a more powerful process. Data bounding (modification of statistically improbable data values) is an inherently non-linear method with considerable promise. Strong bounding depending on two-dimensional least-squares fitting yields a reduction of mottling (buttermilk effect) not attainable with linear processes. A pre-bounding process removing very bad points is used to protect the strong bounding process from incorrectly modifying data points due to the weight of an extreme but yet unbounded point as the fitting area approaches it. (auth)

23610 (CONF-760202-33) MODIFICATION OF RADIATION HAZARDS TO THE ADULT AND ITS FETUS FROM NUCLEAR MEDICINE PROCEDURES. Lathrop, K. A. (Chicago Univ., Ill. (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1976. Contract E(11-1)-69. 25p. Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The effects of perchlorate on the quantitative distribution patterns of /sup 99m/Tc intravenously administered as pertechnetate in the human adult and its fetus were studied in a variety of situations and are summarized. Perchlorate, when administered shortly before /sup 99m/Tc, suppresses concentration in the adult thyroid gland, stomach, and urine; but tends to increase intestinal localization; and prolongs disappearance from the blood. It also inhibits concentration in the placenta and fetus. The greatest reductions in fetal concentrations occur in the femur, spleen, stomach, and thyroid. The estimated radiation absorbed doses to the human fetus are about 80 mrad/mCi for /sup 99m/Tc-pertechnetate alone, and around 30 mrad/mCi if pretreatment with perchlorate is used. Previously localized /sup 99m/Tc may be released by perchlorate from the thyroid gland and stomach, but not from the placenta and fetus. (auth)

23611 (NP-20801) NATIONAL INSTITUTE OF RADIOACTIVE ELEMENTS ANNUAL REPORT, 1974. (Institut National des Radioelements, Brussels (Belgium)). 1974. 68p. (In French). Dep. NTIS (US Sales Only) $4.50.

The technical assistance given in the construction of facilities and methods for monitoring of effluents and other safety aspects in the use of radioisotopes are summarized. The preparation of radioisotopes from irradiated materials and as fission products, the preparation of radiopharmaceuticals and labelled compounds are reviewed. The semi-industrialization or industrialization of the production of kits for routine radioimmunology and the steps taken in the industrialization of a program and process for the radiosterilization of medical supplies and hospital wastes are described. Conference papers and other publications are tabulated. (JSR)

23612 (UCD-472-122, pp 130-131) SCANNING ELECTRON MICROSCOPY OF PRIMARY BONE TUMORS. Pool, R. R.; Kerner, B. Jun 1975.

In annual report, fiscal year 1975. (California Univ., Davis (USA). School of Veterinary Medicine).

Critical-point-drying of tumor tissue fixed in a glutaraldehyde-paraformaldehyde solution and viewed by scanning electron microscopy (SEM) provides a 3-dimensional view of tumor cells and their matrices. This report describes the SEM appearance of three primary bone tumors: a canine osteosarcoma of the distal radius, a feline chondrosarcoma of the proximal tibia, and a canine fibrosarcoma of the proximal humerus. The ultrastructural morphology is compared with the histologic appearance of each tumor. (auth)

23613 STUDY OF THE SEASONAL VARIATION IN THE EXCHANGES OF FOOD LABELLED WITH ^{198}Au FROM A WORKER BEE TO A QUEEN (APIS MELLIFICA LIGUSTICA S.). Pain, J.; Roger, B.; Douault, P. (Institut National de Recherches Agronomiques (INRA), 91-Bures-sur-Yvette (France). Station de Recherches sur l'Abeille et les Insectes Sociaux). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 23, 2677-2680(16 Jun 1975). (In French)

Food exchanges from a worker giver to a queen receiver were quantified throughout the year. Four-days-old workers distribute great amounts of food to queens, about 74% in average, but variations are low. On the other hand workers of unknown age distribute amounts that are less high and varying in terms of the season. A parallelism exists between percentage variations of food shared by workers of unknown age and the seasonal cycle of the 9-oxodec-2-enoic acid content of queens. (FR)

23614 RESOLUTION OF THE HYDROXYAPATITE CRYSTAL LATTICE IN BONE AND DENTAL ENAMEL BY ELECTRON MICROSCOPY. Selvig, K. A. (Bergen Univ. (Norway)). pp 41-51 of Physico-Chemistry and Crystallography of Apatites of Biological Interest. Paris, France; Centre National de la Recherche Scientifique (1975).

From international colloquium on physico-chemistry and crystallography of apatites of biological interest; Paris, France (10 Sep 1973). (Centre National de la Recherche Scientifique, 75-Paris (France)).

The molecular and atomic structure of hydroxyapatite was studied by transmission electron microscopy. The form, size and packing of hydroxyapatite crystals in sections of bone and dental hard tissues could be determined. Lattice fringe patterns with repeat distances in the range 2.7 to 8.2 A occurred in images of individual crystals. On the basis of these fringes the true orientation of the crystals relative to the plane of sectioning was calculated. The observed crystal lattice spacings and interplanar angles were in close agreement with data derived from X-ray diffraction analysis. This study shows that the possibility exists of relating crystallographic analysis to the morphology and fine structure of calcified tissue in health and disease. (FR)

23615 CONVERSION OF PREGNENOLONE 16-^{3}H AND PROGESTERONE-4-^{14}C TO RADIOACTIVE TESTOSTERONE BY THE 18-DAY EMBRYONIC MOUSE TESTIS. Pointis, G.; Lombard, M. N.; Guichard, A.; Cedard, L. (College de France, 75 - Paris. Lab. d'Histophysiologie; Centre Hospitalier Universitaire Cochin-Port-Royal, 75 - Paris (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 23, 2685-2688(16 Jun 1975). (In French).

Fetal mice testes convert pregnenolone-16-^{3}H and progesterone-4-^{14}C to testosterone in organ culture. The $^{3}H/^{14}C$ ratio in progesterone and testosterone fractions isolated from culture media suggests the importance of the Δ^{5}-3β hydroxysteroid pathway in the experimental conditions. LH decreases radioactive testosterone production and increases the activity of the Δ^{4}-3-ketosteroid pathway. (FR)

23616 BONE SCINTIGRAPHY BY USING ^{99m}Tc-PYROPHOSPHATE. Kaneti, J.; Mlackov, H. Rentgenol. Radiol.; 13: No. 3, 137-142(1974). (In Russian)

Sixty-eight scintigraphic examinations by using ^{99m}Tc-pyrophosphate were made to 24 patients suffering from various bone diseases. The investigations revealed that this radiopharmaceutic agent possesses a pronounced bone affinity and furnishes a good-quality scintigraphic image of the bones, in some cases better than the one obtained by $^{85}SrCl_2$. The high radioactivity concentration in the urinary bladder region sometimes covers the neighboring pelvic bones, but this inadequacy could be dealt with by undertaking the scintigraphic examination after urinary bladder contents are voided. The radiation burdening of the bones and particularly of the bone marrow by using ^{99m}Tc-pyrophosphate proves to be considerably lower than the one when $^{85}SrCl_2$ is being applied. Whereas according to literature data non-radioactive stannic pyrophosphate, which is the initial product in obtaining ^{99m}Tc-pyrophosphate, may be kept for several weeks in frozen condition, this term amounts to 4 to 5 months according to observations of the authors. (Abstr. Bulg. Sci. Med. Lit.)

23617 MECHANISMS OF OSTEOPOROSIS. Skosey, J. L. pp 315-333 of Pathobiology Annual 1974. Ioachim, H. L. (ed.). New York; Appleton-Century-Crofts (1974).

A review of the mechanisms of osteoporosis includes the following topics: biology of bone; collagen metabolism; effects of hormones on bone metabolism; effects of nutritional factors and drugs on bone metabolism; osteoporosis associated with hereditary diseases; and possible mechanisms in primary osteoporosis. Calcium-45, ^{14}C, and tritium were used as tracers in studies on collagen synthesis. (HLW)

23618 USE OF ISOTOPE (^{131}I) TO DETERMINE THE INFILTRATION PROPERTY OF THE INTESTINES. Sarkisyan, E. Kh.; Rakhman, L. E.; Galstyan, A. M. Vop. Radiobiol., Sb. Tr.; 6: 279-283(1967). (In Russian)

Iodine isotope (^{131}I) can be successfully used to determine the infiltration properties of the small and the large intestine and

selective concentration property in the thyroid gland. Based on the data of 201 experiments it was proved that iodine isotope is absorbed from the jejunum 3 minutes after administration, while from the ileum 4 minutes after administration. The infiltration of the preparation takes place from the sigmoid colon in the 7th minute. The tracer method to determine infiltration capability of the intestines is a promising and easy method which does not require complicated apparatus and a long time. (auth)

23619 RADIOISOTOPE DIAGNOSIS OF LUNG TUMORS, WITH PARTICULAR REFERENCE TO POSITIVE TRACERS. Chiappa, S.; Bergonzi, M.; Romussi, M. (Dall'Istituto di Radiologia, Terapia Fisica e Medicina Nucleare, Milan). Radiol. Med.; 61: No. 5, 401-414(May 1975). (In Italian)

Lung scintiscans were performed with three tracers: ^{197}Hg-chloride, ^{67}Ga-citrate, ^{113m}In-labelled albumin microspheres, in 64 cases (47 with primary lung cancer). The results are discussed and some cases are presented. ^{197}Hg and ^{67}Ga proved about 95% positive in the lung cancer group. (auth)

23620 SCINTIGRAPHIC LOCALIZATION OF LUNG TUMORS WITH $^{197}HgCl_2$ AND ^{67}Ga CITRATE. Serial Trials. D'Addabbo, A.; Conte, E.; Fanfani, G.; Donato, V. (Univ., Bari, Italy). Radiol. Med.; 61: No. 5, 415-418(May 1975). (In Italian)

A series of lung tumors were subjected to scintigraphy with ^{67}Ga and with $^{197}HgCl_2$. Of these 43 cases where chosen in which only one of the two tracers gave a positive indication. Serial analysis showed the superiority of ^{67}Ga. (auth)

23621 EEG IN BRAIN ABSCESS: ITS VALUE IN LOCALIZATION COMPARED TO OTHER DIAGNOSTIC TESTS. Vignaendra, V.; Ghee, L. T.; Chawla, J. (Univ. of Malaya, Kuala Lampur). Electroencephalogr. Clin. Neurophysiol.; 38: No. 6, 611-622(Jun 1975).

The EEG records of 13 cases of brain abscess were reviewed for their value in localization. Of the 11 cases of supratentorial abscesses localization was achieved in 10, and correct lateralization in the remaining 1 case. Two other cases were cerebellar abscesses; 1 of them showed a false cerebral localization; the other showed no focal abnormalities. The most consistent EEG localizing sign was focal arrhythmic delta waves. These were as slow as 0.5 c/sec in 6 of the 13 cases. Indium brain scans were done in 6 supratentorial abscesses and provided correct or approximate localization in 5. Carotid angiograms were also done in 7 cases and localized the abscess in 6. Findings show that the EEG is comparable to brain scans and contrast radiological studies in localizing supratentorial abscesses. We feel that the combination of EEGs and brain scans is a safe means for providing an early localization in suspected brain abscess. (auth)

23622 HORIZONTAL GRADIENT IN VENTILATION DISTRIBUTION DUE TO A LOCALIZED CHEST WALL ABNORMALITY. Demedts, M.; De Roo, M.; Vandecruys, A.; Bobbaers, H.; Cosemans, J.; Van De Woestijne, K. P. (Akademische Zickenhuis, St. Rafael, Belgium). Am. Rev. Respir. Dis.; 111: No. 6, 781-786(Jun 1975).

Horizontal gradients in the distribution of ventilation and of regional vital capacities, as well as a reversed vertical, esophageal pressure gradient, were observed in a patient with a unilateral painful chest wall lesion. The distribution abnormalities disappeared after surgical treatment. These findings suggest that the interdependency between chest wall and lungs, and within the latter, between lobes, is an important factor determining the regional distribution of ventilation and the pleural pressure gradient in man. (auth)

23623 MYOCARDIAL PERFUSION IMAGING WITH /sup 99m/Tc OR /sup 113m/In MACROAGGREGATED ALBUMIN: CORRELATION OF THE PERFUSION IMAGE WITH CLINICAL, ANGIOGRAPHIC, SURGICAL, AND HISTOLOGIC FINDINGS. Hamilton, G. W.; Ritchie, J. L.; Allen, D.; Lapin, E.; Murray, J. A. (Seattle Veterans Administration Hospital). Am. Heart J.; 89: No. 6, 708-715(Jun 1975).

Scintillation camera myocardial perfusion images were performed in 77 patients with proved or suspected ischemic heart disease following the intracoronary injection of 1.5 mCi /sup 99m/Tc or /sup 113m/In macroaggregated albumin. Perfusion images were classified as normal (36) or abnormal (41), and the location of abnormality was noted. Thirty-seven out of 41 patients with abnormal images had prior myocardial infarction based on history (30), ECG Q-waves (27), local contraction pattern abnormality (23), or direct surgical (9) or histologic (4) inspection, either singly or in combination. Three out of five patients with pre-infarction angina had image defects—none had evidence of infarction by ECG, ventriculogram, or surgical inspection. Coronary artery stenosis correlated with image defects to the extent that myocardial infarction was associated; 28 out of 29 patients with total occlusions and other evidence of infarction had image defects, four patients with complete occlusions but without other evidence of infarction had normal images. We conclude that, excepting patients with preinfarction angina, this technique is more sensitive and direct in the identification of myocardial scar than standard ECG, clinical evaluation, or biplane left ventriculography. (auth)

23624 SEMIAUTOMATED RADIOIMMUNOASSAY FOR MASS SCREENING OF DRUGS OF ABUSE. Sulkowski, T. S.; Lathrop, G. D.; Merritt, J. H.; Landez, J. H.; Noe, E. R. (Air Force School of Aerospace Medicine, Brooks Air Force, TX). J. Forensic Sci.; 20: No. 3, 524-526(Jul 1975).

A rapid, semiautomated radioimmunoassay system for detection of morphine, barbiturates, and amphetamines is described. The assays are applicable to large drug abuse screening programs. The heart of the system is the automatic pipetting station which can accomplish 600 pipetting operations per hour. The method uses 15 to 30 ml for the amphetamine and combined morphine/barbiturate assays. A number of other drugs were tested for interference with the assays and the results are discussed. (auth)

23625 DIFFICULTIES IN PREPARING MAGISTRAL RADIOPHARMACEUTICALS. Eysselt, M. (Universita J. E. Purkyne, Brno (Czechoslovakia). Lekarska Fakulta). Cesk. Farm.; 22: No. 4, 183-184(May 1973). (In Czech)

Problems are dealt with related to the preparation of magistral radiopharmaceuticals and to the equipment required. The radiopharmaceuticals considered are mainly those containing short-lived γ emitters, e.g. ^{99m}Tc and ^{113m}In. (INIS)

23626 METHODS FOR MULTIPLE STEROID RADIOIMMUNOASSAY. Parker, C. R. Jr.; Ellegood, J. O.; Mahesh, V. B. (Medical Coll. of Georgia, Augusta). J. Steroid Biochem.; 6: No. 1, 1-8(Jan 1975).

Modifications of partition column chromatography techniques have allowed the simultaneous elution of 7 plasma steroids using celite columns 5 cm. in length. Utilizing specific antisera, blood levels of estradiol-17β(E_2), progesterone, 17-hydroxy-progesterone, testosterone, androstenedione, dehydroepiandrosterone (DHA), and 5α-dihydrotestosterone (DHT), have been determined in normal men and normal and hirsute women. The results are in close accord to steroid levels found by various investigators using other methods of analysis. The method has considerable advantage over published methods in its versatility and the need for only small blood samples for multiple steroid determinations. (auth)

23627 COMPARATIVE EVALUATION OF ANTISERA FOR 5α-DIHYDROTESTOSTERONE RADIOIMMUNOASSAY. Parker, C. R. Jr.; Ellegood, J. O.; Mahesh, V. B. (Medical Coll. of Georgia, Augusta). J. Steroid Biochem.; 6: No. 1, 9-13(Jan 1975).

A comparison was made between two antisera, one (A-3) which was prepared in our laboratory and another (S-741) which was purchased to be used for the assay of both testosterone and 5α-dihydrotestosterone (DHT). The comparison was made to evaluate the usefulness of these two antisera to be used for DHT assay in the context of a multiple steroid radioimmunoassay system. We wish to report that considerable interference by such compounds as androstenedione and dehydroepiandrosterone (DHA) was encountered when using S-741 while there was little interference when A-3 was utilized for DHT assay. Differences in plasma levels of DHT obtained using antisera A-3 and S-741 are explained by cross reactivity findings in this study. (auth)

23628 RADIOIMMUNOASSAY OF PROGESTERONE: COMPARISON OF [1,2,6,7-$^3H_4$]-PROGESTERONE AND PROGESTERONE-[^{125}I]-IODOHISTAMINE RADIOLIGANDS. Scarisbrick, J. J.; Cameron, E. H. D. (Welsh National School of Medicine, Cardiff, Wales). J. Steroid Biochem.; 6: No. 1, 51-56(Jan 1975).

A number of anti-progesterone-11α-hemisuccinyl-BSA (anti-progesterone-11α-BSA) sera and an anti-progesterone-3-(O-carboxymethyl) oximino-BSA serum were examined with regard to their behaviour with [^{3}H]-progesterone, progesterone-11α-hemisuccinyl-[^{125}I]-iodohistamine (progesterone-11α-[^{125}I]) and progesterone-3-(O-carboxymethyl) oximino-[^{125}I]-iodohistamine radioligands. The features investigated included the ability of the antisera to bind each radioligand, the degree of inhibition of this binding by radioinert progesterone and the cross-reactions of various steroids in the several systems. The [^{3}H]-progesterone gave results with all sera which agreed with those already recorded in the scientific literature but the data obtained enabled comparison with those systems involving the use of the iodinated ligands. Out of a number of sera tested only one anti-progesterone-11α-BSA serum showed sufficient inhibition of binding of the homologous progesterone-11α-[^{125}I] ligands (at a dilution of 1:60,000 as compared to 1:8,000 with [^{3}H]-progesterone) on addition of

radioinert progesterone to allow the setting up of a viable radioimmunoassay system but the cross-reactions observed were the lowest of all systems investigated. Consequently, following a comparison of assay criteria using this unique antiserum with both ^{3}H- and ^{125}I-labelled radioligands it was concluded that the use of the ^{125}I-labelled material possessed all the advantages of the [^{3}H]-progesterone and in addition would be less expensive and more convenient particularly when large numbers of analyses were required. (auth)

23629 CINEANGIOCARDIOGRAPHY WITH ^{99m}Tc AND STANDARD ANGER CAMERA OF NORMAL PERSONS AND EXAMPLES IN THE DIAGNOSIS OF SOME SURGICAL CARDIAC PATIENTS. Fernandes, F. V.; Godinho, F. M.; Nogueira, A. C. R. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 31-35(Apr 1974). (In Portuguese)

The results obtained in the first 100 cases studied by direct visualization of the heart blood flow with techetium and γ camara are presented. The registration of the radioactive bolus injected in an arm vein was made both in a video magnetic tape system and in a photographic film, where the sequence of expositions has been previously determined. Thirty three normals were first studied to determine the cardiac and the great vessels configuration pattern in the different positions, and the heart transit time. These values were compared with those obtained from the study of the radiocardiogram in a small number of cases. The importance of this study in the diagnostic interpretation of some congenital and acquired diseases of the heart and great vessels is emphasized. Some examples are presented that show the interest of the method as a means of morphologic identification and of physiologic assessment of the cardiac blood flow changes in a wide variety of these diseases. (auth)

23630 ^{131}I STUDY OF 21 PATIENTS WITH LINGUAL SWELLING. Clode, W. H.; Fernandes, F. V.; Ferreira, I. B. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 81-87(Apr 1974). (In Portuguese)

Twenty-one patients with lingual localization of the thyroid tissue from a large group of 25,000 patients studied with thyroid scanning and determination of radio-iodine uptake are presented. About 20% of the patients had clinical signs and laboratorial values corresponding to hypothyroidism. The ectopic goiter was the only functioning thyroid tissue present. Clinically 18 patients had a rounded swelling at the base of the tongue, which did not always cause symptoms related with the volume of the mass. In 8 patients surgical exploration was performed. Microscopic studies of three cases and a microautoradiography of the ectopic tissue are discussed. (auth)

23631 CINEANGIOGAMMAGRAPHS IN CEREBRAL TUMORS. Coutinho, A. C.; Godinho, F.; Baptista, A. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 77-80(Apr 1974). (In Portuguese)

In 14 cases of brain tumors the authors discuss results obtained with the angiogammagraphy technique considering the histological type of tumors. The advantages of the technique as a means to increase the diagnostic rigour and the probability of tumor detection are emphasized. (auth)

23632 CEREBRAL GAMMAGRAPHY WITH PERTECNETATE ^{99m}Tc USING A γ CAMERA. Coutinho, A. C.; Godinho, F.; Baptista, A. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 71-75(Apr 1974). (In Portuguese)

After review of the mechanisms of fixation of the radionuclides in cerebral lesions and emphasizing the advantages of the γ radiation of ^{99m}Tc by the gammacamera for the location of cerebral neoplasms the authors studied a group of 63 patients submitted to cerebral gammagraphy. They think that, owing to its innocuity, accuracy and to the lack of discomfort to the patient, the method is, like the E. E. G. or the Eco E. G., particularly fit to be carried out on patients. (auth)

23633 RADIOACTIVE DIGESTED ALBUMIN: A NEW AGENT FOR GAMMAGRAPHIC VISUALIZATION OF THE KIDNEYS. Baptista, A. M.; Santos, R. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 67-70(Apr 1974). (In Portuguese)

By action of pepsin on human serum albumin, low molecular weight residues can be formed. Labelling with appropriate radionuclides as ^{99m}Tc or ^{131}I can be done either before or after attack with pepsin. The method of preparation and results are described and discussed. (auth)

23634 RENAL GAMMAGRAPHY WITH TRASYLOL LABELLED WITH ^{99m}Tc AND ^{131}I. Baptista, A. M.; Nogueira, A. R. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 63-66(Apr 1974). (In Portuguese)

In this work the authors present some renal gammagraphies obtained with Trasylol labelled with ^{99m}Tc. The process of labelling is based on that described by Cooper, Stern, and Deland for labelling human albumin. The new radioactive agent has certain definite advantages over the frequently used organo-mercury products. (auth)

23635 STUDY OF THE TRANSVERSE RENAL ARTERIES BY CINEAORTOGAMMAGRAPHY WITH ^{99m}Tc. Prata, M. M.; Fernandes, F. V.; Godinho, F. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 59-61(Apr 1974). (In Portuguese)

Nuclear cineaortogammagraphy is a safe and simple method of diagnosis whose results are easily and rapidly obtained. The morphology of blood vessels and the dynamic study of circulation which it allows could be of real value in the diagnosis of the renal artery permeability. In this paper the value of cineaortogammagraphy in the diagnosis of partial and total obstruction of the renal artery is discussed. (auth)

23636 GAMMAGRAPHIC DIAGNOSIS OF RENAL TUMORS AND CYSTS. Prata, M. M.; Fernandes, F. V.; Godinho, F. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 55-58(Apr 1974). (In Portuguese)

Renal cysts and tumors appear as cold areas without radioactive fixation, in the gammagraphic studies obtained after intravenous administration of ^{99m}Tc-Albumine or ^{131}I-Hippuran. In these cases cineaortography with ^{99m}Tc allows the differential diagnosis by the presence of vascularization in the tumors and its absence in the cysts as it is shown by the radioactive technetium in 22 patients of our series. The value of nuclear methods of diagnosis are compared with the classic radiographic technics. (auth)

23637 STUDY OF VENTILATION BY INHALATION OF ^{133}Xe IN DOGS. Its Interest for Pulmonary Autotransplantation. de Noronha, L. L.; Godinho, T. M. (Hospital Escolar de Santa Maria, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 51-54(Apr 1974). (In Portuguese).

This is a preliminary report on the use of ^{133}Xe for the study of the pulmonary ventilation in dogs as part of an experimental work on pulmonary transplantation. With a γ camera gammagraphic images were obtained, and dynamical studies were performed in normal dogs (4) and in 8 animals after autotransplantation, at different times after operation. (auth)

23638 GAMMAGRAPHIC DIAGNOSIS OF EXPERIMENTAL SYSTEMIC-PULMONARY ANASTOMOSIS. Fernandes, F. V.; Pinheiro, M. F.; Godinho, F. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 45-49(Apr 1974). (In Portuguese)

The purpose of this work was to study in experimental conditions the changes, not yet clearly defined, of cardio-pulmonary circulation after systemic-pulmonary anastomosis. Two isotopic methods have been used: one a static method, the lung gammagraphy with ^{99m}Tc-MA, and another a dynamic one, the cineangiocardiogammagraphy with ^{99m}Tc. In animals who have undertaken arterial shunts, the lung uptake of radioactive particles on the side of a well functioning anastomosis is less than on the contralateral side. Angiocardiographic studies with ^{99m}Tc demonstrate that these images are due to the partial blockage of the blood passage from the right ventricle to the lung to which the surgical aorto-pulmonary shunt was constructed. Our results have confirmed the value of lung gammagraphy as a safe and useful method to show the patency of venous shunt between the superior vena cava and right pulmonary artery. It was verified that the separated measurement of the ^{99m}Tc-MA in each lung will allow the quantification of the degree of venous anastomosis between the territory of the superior and inferior vena cava, and indirectly could evaluate the degree of superior vena cava hypertension. Isotopic angiocardiography with ^{99m}Tc made evident the slow flow of blood through the right lung in these venous shunts, which determine also identical slow perfusion in the contralateral lung. (auth)

23639 GAMMAGRAPHIC DIAGNOSIS OF MYXOMA OF THE LEFT ATRIUM. Fernandes, F. V.; Godinho, F. M.; Santos, R.; Baptista, A. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 41-43(Apr 1974). (In Portuguese)

Two cases of myxoma of the left atrium studied with blood poll scanning and cineangiocardiography with ^{99m}Tc and γ camera are presented. The diagnostic value of the two gammagraphic methods in these cases is comparatively analyzed. (auth)

23640 PRE- AND POSTOPERATIVE STUDY WITH CINEANGIOCARDIOGAMMAGRAPHY OF COGENITAL AND ACQUIRED HEART DISEASES. Fernandes, F. V.; Godinho, F. M.; Nogueira, A. R. (Instituto Portugues de Oncologia de Francisco Gentil,

Lisbon). Arq. Patol. (Lisbon); 46: No. 1, 37-40(Apr 1974). (In Portuguese)

From 6th European congress of cardiology; Madrid, Spain (1972).

Nuclear angiocardiography has been performed in 130 cardiovascular patients using an Anger scintillation camera and 5 to 10 millicuries of technetium injected in a peripheral vein. The circulatory heart transit time and the normal pattern of the heart cavities in different projections was studied in 40 individuals. The results indicate that the method allows the morphologic identification and the physiologic assessment of cardiac blood flow changes in a wide variety of congenital and acquired diseases of the heart and great vessels. The wide scope of diagnostic applicability of the procedure is emphasized by comparison with the images sequences obtained before and after surgical therapy. The low risk and simplicity of this technic provides a new approach for visualization of the cardiovascular system under more physiological conditions and makes it promising not only as a screening procedure and an adjunct to cardiac catheterization but as an easy guide to study the effects of surgical interventions upon the cardiovascular system. (auth)

23641 EFFECTIVENESS OF DIRECT AND INDIRECT RADIONUCLIDE CYSTOGRAPHY IN DETECTING VESICOURETERAL REFLUX. Conway, J. J.; Kruglik, G. D. (McGaw-Northwestern Univ. Medical Center, Chicago). J. Nucl. Med.; 17: No. 2, 81-83(Feb 1976).

A modification of the direct radionuclide cystography technique to include filling, voiding, and postvoiding phases of the examination permitted a simulated comparison between direct and indirect radionuclide cystography. One hundred thirty-seven examples of reflux were documented with this technique. Of these, 96 instances of reflux (70 percent) were recorded during two or more phases and thus would have been detected by either technique. Twenty-nine examples (21 percent) were only detected during filling and thus would have been missed by the indirect radionuclide technique and by some roentgenographic techniques. Only 12 examples (9 percent) were detected during the voiding phase only. The modified direct method of radionuclide cystography, which continuously monitors the urinary tracts during filling, voiding, and postvoiding, is offered as the best current technique for assessing vesicoureteral reflux. (auth)

23642 RADIONUCLIDE DETERMINATION OF CARDIAC CHAMBER FLOW/VOLUME CHARACTERISTICS. Freedman, G. S.; Dwyer, A.; Wolberg, J. (Yale Univ. School of Medicine, New Haven). J. Nucl. Med.; 17: No. 2, 84-87(Feb 1976).

From 20th annual meeting of the society of nuclear medicine; Miami, FL (Jun 1973).

The flow/volume characteristics of an externally monitored radionuclide dilution curve may contain valuable information about specific cardiac chamber abnormalities. A simplified method of obtaining this flow/volume ratio on a standard scintillation camera is presented. Preliminary clinical application to right-sided cardiac lesions has been undertaken. The implications of flow/volume variation with time are discussed. (auth)

23643 INITIAL ASSESSMENT OF A SIMPLE FUNCTIONAL IMAGE OF VENTILATION. Alpert, N. M.; McKusick, K. A.; Correi, J. A.; Shea, W.; Brownell, G. L.; Potsaid, M. S. (Massachusetts General Hospital, Boston). J. Nucl. Med.; 17: No. 2, 88-92(Feb 1976).

Several methods for quantitatively measuring regional ventilation using an inert gas such as ^{133}Xe have been described. One such method provides a functional image of washout. A particularly simple functional image may be derived from the mean transit time for clearance. Regional ventilation may thus be represented as a single image in which the spatial distribution of washout from multiple small regions of the lung is displayed. In 100 patients for whom such a functional image of ventilation was obtained, the functional image was found to be generally more useful and easier to interpret than sequential images taken during the period of washout. Distributions of half-time (t/sub 1/2/) for washout and the mean transit time (anti t) in the same population were similar in shape, but the anti t distribution peaked about 15 sec later than the t/sub 1/2/ distribution. The mathematical simplicity of the functional image described here should permit its implementation on virtually any nuclear medicine computer system. (auth)

23644 RELATIVE ACCRETION OF /sup 99m/Tc-POLYPHOSPHATE BY FORMING AND RESORBING BONE SYSTEMS IN RATS: ITS SIGNIFICANCE IN THE PATHOLOGIC BASIS OF BONE SCANNING. Garcia, D. A.; Tow, D. E.; Kapur, K. K.; Wells, H. (Veterans Administration Hospital, West Roxbury, MA). J. Nucl. Med.; 17: No. 2, 93-97(Feb 1976).

From 22nd annual meeting of the society of nuclear medicine; Philadelphia, PA (17 Jun 1975).

The relative roles of osteogenesis and osteolysis in the production of positive radionuclide images of skeletal lesions were investigated. The uptake of /sup 99m/Tc-polyphosphate (Tc-PP) by each process was measured in an animal model that permitted bone formation and resorption to be studied independently. Ten rats received intramuscular implants of bone-forming demineralized matrix (DM) and resorbing devitalized bone (DV). Radiographs and Tc-PP scintiscans were made each week thereafter. At 6 to 10 weeks, the implants and normal bone samples were removed, counted for /sup 99m/Tc, and examined histologically. The uptake of Tc-PP by DM implants was first detected on images made 3 weeks after implantation, and by DV implants, 1 to 2 weeks later. Serial radiography showed progressive calcification of DM and resorption of DV implants. Microscopic examinations of undecalcified sections, stained with a modified Goldner preparation, revealed vital-bone formation in the DM implants and osteoclastic resorption in the DV. Activity counts per gram of DM and DV implants were, respectively, 200 percent and 90 percent that of normal bone. Since only the bone-forming system (DM) accumulated Tc-PP at greater than normal concentrations, this study indicates that positive bone images of osteolytic lesions solely reflect compensatory osteogenic responses. (auth)

23645 COMPARISON OF ^{18}F AND /sup 99m/Tc-POLYPHOSPHATE IN ORTHOPEDIC BONE SCINTIGRAPHY. Heerfordt, J.; Vistisen, L.; Bohr, H. (Niels Bohr Inst., Copenhagen). J. Nucl. Med.; 17: No. 2, 98-103(Feb 1976).

To compare /sup 99m/Tc-polyphosphate and ^{18}F for use in orthopedics, 79 patients were examined with both. Fifty cases were suitable for analysis. While the extraskeletal uptake of ^{18}F was found to be negligible, /sup 99m/Tc-polyphosphate may accumulate considerably in pathologic soft tissue, e.g., in soft-tissue tumors and in inflamed synovial tissue. This soft-tissue Tc accumulation may obscure the osseous uptake, notably in the examination of joint regions, commonly the regions of interest in orthopedics. After simultaneous administration of both agents, quantitative measurements were performed on specimens of bone and synovial tissue from diseased joints in human patients and in rabbits. The uptake of /sup 99m/Tc-polyphosphate in synovial tissue was shown to be about seven times that of ^{18}F, while their uptakes in bone were equal. In short, /sup 99m/Tc-polyphosphate, a valuable tracer in general, is hardly the agent of choice in orthopedics. (auth)

23646 MARKED SUPPRESSION OF THYROID FUNCTION IN RATS WITH GRAM-NEGATIVE SEPTICEMIA. Kan, M. K.; Garcia, J. F.; McRae, J.; Chang, L. T.; Linfoot, J. A.; Perez-Mendez, V. (Univ. of California, Berkeley). J. Nucl. Med.; 17: No. 2, 104-107(Feb 1976).

Gram-negative septicemia was induced in rats by two daily injections of fecal mixture into the thigh, after which the thyroid function was markedly suppressed for 2 days. Iodine metabolism was studied by organ radioassay and by imaging with a multiwire proportional chamber (MWPC) at various time intervals after intravenous injection of ^{125}I. Plasma T_3, T_4, and TSH, measured by radioimmunoassays, were suppressed, as were the T_3-resin uptakes. Fractional blood supply to the thyroid glands of the infected rats, studied by the ^{81}Rb uptake method, was also found to be markedly reduced. Sections of the thyroid glands showed little structural change during the period of marked thyroid suppression. There was no biochemical evidence of renal failure in the septicemic rats. (auth)

23647 SPLENIC ACCUMULATION OF /sup 99m/Tc-DIPHOSPHONATE IN A PATIENT WITH SICKLE CELL DISEASE: CASE REPORT. Goy, W.; Crowe, W. J. (Maricopa County General Hospital, Phoenix, AZ). J. Nucl. Med.; 17: No. 2, 108-109(Feb 1976).

Splenic accumulation of /sup 99m/Tc-diphosphonate is shown in the bone scan of a patient with sickle cell disease. This uptake is assumed to result from splenic infarction and subsequent calcification. The conventional liver-spleen scan with /sup 99m/Tc-sulfur colloid shows no splenic activity, and a radiograph shows calcification in the left upper quadrant of the abdomen in the expected anatomic location of the spleen. (auth)

23648 DIAGNOSIS OF POSTEROLATERAL CONGENITAL DIAPHRAGMATIC (BOCHDALEK) HERNIA BY LIVER SCINTIGRAM: CASE REPORT. Yeung, W. C.; Haines, J. E.; Larson, S. M. (Univ. of Oregon Health Sciences Center, Portland). J. Nucl. Med.; 17: No. 2, 110-112(Feb 1976).

A characteristic liver scintigraphic finding was observed in a 2-month-old infant with hepatic herniation through a right-sided posterolateral congenital diaphragmatic defect (Bochdalek). The liver scintigrams showed an oblique band of de-

creased radioactivity dividing the liver into an inferior anteromedial portion and a superior posterolateral portion. In spite of the markedly abnormal liver scintigram, other diagnostic studies, including pneumoperitoneum abdominal radiography, remained negative. The liver scintigram can provide life-saving information in the diagnosis of congenital diaphragmatic hernia, as in the present case. The distinctive liver-scan findings among the various types of common diaphragmatic hernias are also briefly reviewed. (auth)

23649 INCREASED LOCALIZATION OF /sup 99m/Tc-PYROPHOSPHATE IN A BONE ISLAND: CASE REPORT. Sickles, E. A.; Genant, H. K.; Hoffer, P. B. (Univ. of California School of Medicine, San Francisco). J. Nucl. Med.; 17: No. 2, 113-115(Feb 1976).

A positive /sup 99m/Tc-pyrophosphate bone scan is reported in a proven case of large compact bone island. Pyrophosphate uptake in this case is presumed to be due to either large size or growth of the bone island. A radionuclide bone scan does not always differentiate bone islands from metastatic or inflammatory sclerotic bone lesions. (auth)

23650 ADENOCARCINOMA OF THE LUNG WITH MARKED UPTAKE OF /sup 99m/Tc-PERTECHNETATE: CASE REPORT. Patton, D. D.; Hertsgaard, D. B. (Vanderbuilt Univ., Nashville). J. Nucl. Med.; 17: No. 2, 116-118(Feb 1976).

Following biopsy of a hilar mass, a heart scan performed with /sup 99m/Tc-pertechnetate showed intense uptake in the mass. The degree of radionuclide concentration suggested that the mass was glandular tissue, most likely an adenoma or adenocarcinoma. Biopsy revealed a mucinsecreting adenocarcinoma. Review of the literature showed examples of active glandular concentration of pertechnetate in the thyroid, gastric mucosa, salivary glands, choroid plexus, nasal mucosa, breast, lacrimal glands, and colon. This case provides an example of reasoning by which the scan interpretation came closer to the actual tissue diagnosis than is usually possible. (auth)

23651 TRACER ACCUMULATION IN A SUBDURAL HYGROMA: CASE REPORT. So, S. K.; Ogawa, T.; Gerberg, E.; Sakimura, I.; Wright, W. (Santa Teresita Hospital, Duarte, CA). J. Nucl. Med.; 17: No. 2, 119-121(Feb 1976).

A surgically proven case of traumatic subdural hygroma gave a "positive" image during ^{111}In-DTPA cisternography. This was probably secondary to a communication between the subdural and subarachnoid spaces. (auth)

23652 TAGGING OF IRON OXIDE PARTICLES WITH /sup 99m/Tc FOR USE IN THE STUDY OF DEPOSITION AND CLEARANCE OF INHALED PARTICLES. Hass, F. J.; Lee, P. S.; Lourengo, R. V. (Univ. of Illinois, Chicago). J. Nucl. Med.; 17: No. 2, 122-125(Feb 1976).

This paper describes a method of tagging iron oxide aerosol particles with /sup 99m/Tc. The tagging is achieved by reducing the heptavalent pertechnetate form to its reduced state using stannous chloride in a nitrogen atmosphere. Tests by ultracentrifugation and paper chromatography show that the tagging is virtually complete. Separation of the tag from the particles in sputum is shown to be minimal. Monodisperse aerosols of the tagged particles are produced with a spinning-disk atomizer. (Deposition and clearance of the particles in the airways and lungs is easily followed by scintigraphy.) Factors affecting attachment and separation of the tag are discussed. (auth)

23653 SIMPLE KIT FOR THE PREPARATION OF /sup 99m/Tc-LABELED RED BLOOD CELLS. Smith, T. D.; Richards, P. (Brookhaven National Lab., Upton, NY). J. Nucl. Med.; 17: No. 2, 126-132(Feb 1976).

From 21st annual meeting of the society of nuclear medicine; Philadelphia, PA (11 Jun 1974).

A simple kit for the preparation of /sup 99m/Tc-labeled red blood cells in a closed sterile system is described. Whole blood (3 to 6 ml) is automatically drawn from the patient into a 10-ml Vacutainer tube, containing a freeze-dried stannous citrate formulation, with heparin as an anticoagulant. The kit provides consistent 97 percent yields in 20 min with small blood samples. The radionuclide is added at the end of the labeling sequence to minimize operator exposure. Freeze-dried kits have performed well after more than 12 months. Some technetium solutions produced low labeling yields. Experimental evidence suggests that the poor yields were due to carrier /sup 99m/Tc. This effect may explain low labeling yields obtained with some other radiopharmaceuticals. (auth)

23654 EVALUATION OF LABELLING PROCEDURES AND IN VIVO STABILITY OF /sup 99m/Tc-RED BLOOD CELLS. Ryo, U. Y.; Mohammadzadeh, A. A.; Siddiqui, A.; Colombetti, L. G.; Pinsky, S. M. (Univ. of Chicago). J. Nucl. Med.; 17: No. 2, 133-136(Feb 1976).

Stable labeling of red blood cells (RBCs) with /sup 99m/Tc, in yields of about 66 percent, was achieved by using stannous chloride as a reducing agent. In a study of 12 patients, the stability of technetium-labeled RBCs in the circulation varied significantly among individuals, but the average biologic half-life of the labeled cells was 16.8 hr. Although the labeling yield was lower when the labeling was carried out without EDTA with the addition of stannous chloride after the pertechnetate, this sequence appears to be the best for labeling RBCs for use in obtaining images of the blood pool or the cardiovascular system because of the increased viability of the RBCs. (auth)

23655 THALLIUM-201: SCINTILLATION CAMERA IMAGING CONSIDERATIONS. Groch, M. W.; Lewis, G. K. (Searle Radiographics, Inc., Des Plaines, IL). J. Nucl. Med.; 17: No. 2, 142-145(Feb 1976).

Modulation transfer functions, line spread functions, and energy spectra were obtained for an Anger scintillation camera using three different collimators and commercially produced ^{201}Tl. Images of a thyroid phantom were obtained using these collimators. For each of the three collimators, line spread functions and modulation transfer functions were obtained for both the 75-keV x-ray and 167-keV gamma photon of ^{201}Tl. Although the intrinsic resolution of the scintillation camera is superior when imaging with the 167-keV gamma photon, system performance was superior when the 75-keV x-ray was imaged. Contamination from ^{202}Tl, which emits abundant 439-keV gamma photons, degraded images taken at 167 keV because of septum penetration. At 75 and 167 keV the converging collimator yielded the best system performance. Imaging time was significantly shorter using the 75-keV x-rays.

MATERIALS

23656 (UCRL-50028-75-4) H-DIVISION QUARTERLY REPORT, OCTOBER-DECEMBER 1975. Grover, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 57p. Dep. NTIS $5.45.

This report presents a brief summary of the overall goals of each of the seven groups comprising H-Division of the Physics Department, and supplies a concise statement of the status of projects under way. References and experimental details are kept to a minimum. The groups included are as follows: theoretical EOS (equation-of-state) group, code development group, experimental EOS group, dynamic materials response group, solid mechanics group, fluid mechanics group, and special projects group (for short-term projects). 24 figures, 6 tables (RWR)

23657 ANGULAR DISTRIBUTION OF HIGH-ENERGY ELECTRONS REFLECTED FROM THE SURFACE OF SOLIDS. Levandovskii, V. G.; Chaika, G. E. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1735-1737(Oct 1975). (In Russian)

The angular distribution of electrons inelastically reflected from the surface of solids was calculated in the steady loss approximation on the basis of kinetic equations. The results agree well with experimental data. (tr-auth)

Ceramics and Cermets

Refer also to abstracts 22702, 23704, 23707, 23715, 23725, 23737, 23745, 23772, 23779, 23800, 23873, 25165, 25166, 25184–25186, 25194, 25195, 25308, and 25309.

23658 (AGARD-R-634) MECHANICAL PROPERTY TESTING OF HIGH TEMPERATURE MATERIALS. Davidge, R. W.; Massmann, J. (Advisory Group for Aerospace Research and Development, 92 – Neuilly-sur-Seine (France)). Dec 1975. 37p.

Research on the mechanical properties of ceramics is reported. Basic concepts of fracture mechanics are discussed along with fundamentals of short-term strength and engineering design. In a second section the application of the Finite Element Method in structural analysis is shown and methods of calculating stress and strain distribution are examined. Plasticity and creep influences are considered. (JRD)

23659 (BNL-20619) FIRST-ORDER TRANSITIONS, SYMMETRY, AND THE EPSILON-EXPANSION. Mukamel, D.; Krinsky, S.; Bak, P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 37p. (CONF-751209-16). Dep. NTIS $5.00.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The group theoretical method of Landau and Lifshitz was used to derive effective Hamiltonians for certain paramagnetic to antiferromagnetic transitions having order-parameters with n greater than or equal to 4 components. A renormalization group analysis in 4-epsilon dimensions was performed. The first-order nature of the order-disorder transitions in Cr(n equals 12), Eu(n equals 12), UO_2(n equals 6), and MnO(n equals 8) can be explained by noting that the corresponding Hamiltonians possess no stable fixed points in 4-epsilon dimensions. It is predicted that all fcc type I(anti m perpendicular anti k), type II and type III(anti m perpendicular [100], anti k equals [1/2 01]) antiferromagnetic transitions are first-order. The work is intended to serve as a guide in an experimental search for new examples of first-order transitions. A 2m-component Hamiltonian is also considered which possesses a unique, nonisotropic, stable fixed point for each value of 2m greater than or equal to 4. When 2m equals 4, the Hamiltonian describes the paramagnetic to antiferromagnetic transitions in $TbAu_2$, DyC_2, Tb, Ho, Dy, and the structural transition in NbO_2. If these transitions are second-order, it is predicted they all belong to the same universality class. For 2m equals 6, the Hamiltonian describes the antiferromagnetic transitions in TbD_2, Nd, K_2IrCl_6, and MnS_2. These transitions belong to a single universality class. (auth)

23660 (BNL-tr-613) NEW HIGH-TEMPERATURE SUPERCONDUCTOR, Nb_3Si. Pan, V. M.; Alekseevskii, V. P.; Popov, A. G.; Beletskii, Yu. L; Yupko, L. M.; Yarosh, V. V. Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 21: No. 8, 494-496(1975). 7p. Dep. NTIS $4.50.

Preparation by explosive bonding of Nb_3Si is described. This compound has a superconducting transition temperature of 18.5 to 19°K.

23661 (DOCKET-701319-5) TEST AND RESEARCH REACTOR FUEL ELEMENT FABRICATION PLANT. IE Inspection Report No. 75-09 and Reply. (United States Nuclear, Inc., Oak Ridge, Tenn.). 3 Feb 1976. 18p. Dep. NTIS $3.50.

Copies of the following documents relating to U. S. Nuclear, Inc., Docket No. 70-1319 are presented: Letter to U. S. Nuclear, Inc. from J. T. Sutherland dated February 3, 1976; Letter to N. C. Moseley from U. S. Nuclear, Inc. dated January 28, 1976; Letter to N. C. Moseley from U. S. Nuclear, Inc. dated January 19, 1976; Letter to U. S. Nuclear, Inc. from N. C. Moseley dated December 22, 1975; and Region II Inspection Report No. 70-1319/75-9. (LK)

23662 (JAERI-M-5977) INTERFEROMETRIC INVESTIGATION OF ION-BOMBARDED SURFACES. Kubo, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1975. 25p. (In Japanese). Dep. NTIS (US Sales Only) $4.50.

The deformations induced by bombardment with the beams of protons, deuterons, α-particles, nitrogen and argon ions from a 2 MV Van de Graaff accelerator on the crystal surfaces of LiF, NaF, UO_2-evaporated NaCl, MgF_2, pyrolytic graphite and germanium were investigated by using a microinterferometer. Occurrences of lattice expansion, swelling and blistering were observed as the ion bombardment effects. Slipping, cracking and flaking, which gave a relaxation of strains resulting from the former actions, have taken place. The appearances of precipitation and amorphization were also observed on the heavy-ion bombarded surfaces. It is concluded that these phenomena vary from crystal to crystal, since they are influenced by the characteristic distributions of lattice defects and temperatures within the bombarded specimen and by its physical properties. The influence of the mechanical properties is considerable. It is noteworthy that the interferometric investigation is one of the most effective methods for study of the radiation damage induced by ion-bombardment; the technique has wide application. (JA)

23663 (LBL-4102) FAR INFRARED SPECTROSCOPY OF SOLIDS. I. Impurity States in Al_2O_3. II. Electron-Hole Droplets in Ge. Aurbauch, R. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Sep 1975. Contract W-7405-Eng-48. 229p. Dep. NTIS $8.00.

Thesis.

Far infrared Fourier transform spectroscopy was used to study the low lying vibronic states of Mn^{3+} in Al_2O_3 and the plasma absorption of electron-hole droplets in Ge. The transmission of Mn-doped samples of Al_2O_3 was measured in the frequency range from 3 to 30 cm^{-1} in applied magnetic fields up to 50 kG. Absorption lines were observed due to both ground and excited state transitions. Polarization measurements established that these absorption lines were due to electric dipole transitions. Temperature dependence measurements were used to derive a level diagram for the low lying states of Mn^{3+}. A phenomenological model based on an electronic Hamiltonian was developed which successfully describes the data. The empirically determined trigonal field and spin-orbit quenching parameters of this model are 0.7 and 0.1 respectively. This quenching is attributed to the dynamic Jahn–Teller interaction. The plasma absorption of small (alpha) electron-hole drops in Ge was measured in the frequency range from 30 to 300 cm^{-1}. The observed absorption is in good agreement with measurements by Vavilov and other workers. A theoretical model which includes both intraband and interband contributions to the dielectric constant in the Rayleigh limit of Mie theory is used to describe the observed lineshape. Measurements of plasma absorption of large (gamma) drops in inhomogeneously stressed Ge were made in magnetic fields up to 50 kG. The lineshape at zero applied field was calculated in the large sphere limit of Mie theory including intraband terms and a zero-strain interband term. Qualitative agreement with experiment was obtained. The peak absorption shifted quadratically with applied magnetic field and the total plasma absorption increased. No oscillatory structure was observed in the field-dependence of the total absorption. (auth)

23664 (NP-20811) INVESTIGATIONS ON CERMET ELECTRODES FOR THERMIONIC EMITTERS. Schmidt, D.; Nazare, S. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e. V., Stuttgart (F. R. Germany). Inst. fuer Energiewandlung und Elektrische Antriebe; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). 1974. 6p. Dep. NTIS (US Sales Only) $3.50.

Unstable Ba_2CaWO_6–W with their own supply of Ba, as well

as stable UO_2–Mo emitter cermets that have to be operated with an external Ba-source, were prepared by axial hot pressing. The relevant properties of these cermets such as electrical resistivity and thermal expansion are reported and compared with theoretical predictions. The electron emission of these materials is discussed on the basis of the surface films formed. It provides the basis for optimizing the behavior of these materials. (6 fig) (auth)

23665 (UCRL-Trans-10743) NOVEL REDUCTION PROCEDURE FOR THE RECTIFICATION OF SmF_2, EuF_2, YbF_2, SmS, YbS, AND EuO. Petzel, T.; Greis, O. Translated from Z. Anorg. Allg. Chem.; 396: 95-102(1973). 14p. Dep. NTIS $3.50.

A technique is described, by which the compounds SmF_2, EuF_2, YbF_2, SmS, YbS, and EuO can be prepared by reduction of the trifluorides, sesquisulfides, and of europium sesquioxide, respectively, with the gaseous rare earth metals. By this technique the contamination of the reaction products with several specific impurities usually contained in the condensed rare earth metals can be avoided. Analytical data and lattice parameters of the compounds prepared by this method are given. (auth)

23666 EFFECT OF POWDER-PARTICLE SIZE ON THE COMPATIBILITY BEHAVIOR OF STAINLESS STEELS WITH URANIUM CARBIDE POWDER. Stumpf, W. E.; Venter, S. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Physical Metallurgy Div.). J. Nucl. Mater.; 58: No. 2, 211-219(Nov 1975).

Vacuum-bonded compatibility tests between slightly hyperstoichiometric UC powders (with a wide range of BET specific surface areas) and stainless steels 304, 304L and 316, were carried out at 600°C and 700°C. It was found that UC powders with BET specific surface areas below $200 m^2/kg$ do not cause any measurable embrittlement, whereas finer powders with BET specific surface areas up to about $1000 m^2/kg$ cause rather substantial embrittlement of the steels. It was further established that the transfer of carbon from the fuel to the cladding occurs largely through the gas phase in this type of test. It is also suggested that in the very fine powders which cause carburisation of the steels, (a) the surface oxidation of these powders was partly indirectly responsible for the carburisation of the steels, but (b) that further carbon transfer from the UC_2 phase in the fuel occurs more rapidly with particles with a very high BET specific surface area than with coarser particles. (NL)

23667 CARBON REDUCTION OF URANIUM DIOXIDE-ELEMENTARY MECHANISMS AND INTERPRETATION OF THE RESULTS. Danger, G.; Besson, J.; Sarrazin, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). J. Nucl. Mater.; 58: No. 2, 196-200(Nov 1975). (In French)

Experimental results from a kinetic study of the reduction by carbon of uranium dioxide are interpreted on the basis of a structural model of the dicarbide. This model presupposes the existence of local defects in octahedral sites normally occupied by C_2 pairs. These defects are on the one hand vacancies and (single) carbon atoms, on the other hand they are oxygen atoms and CO molecules. The theory proposed on the basis of this model leads to the view that the kinetics are governed by the oxygen-bearing defects, while the concentration gradient of the other defects is nil. (NL)

23668 A NUCLEAR FUEL MATERIAL AND THE METHOD FOR MANUFACTURING SAME. Dean, G.; Delafosse, J.; Lorenzelli, R.; Francois, B. (to CEA, 75–Paris (France)). French Patent 2,232,818/A/. 7 Jun 1973. 7p. (In French)

This material is constituted by sintered pellets of uranium oxide and/or transuranic element oxides with a pore diameter of from 4 to 40 microns. This material can be used in light water reactors as well as in fast neutron reactors. (FR)

23669 PHASE DIAGRAM OF TERBIUM ORTHOFERRITE IN A MAGNETIC FIELD. Bidaux, R.; Bouree, J. E.; Hammann, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). J. Phys. (Paris; 36: No. 9, 803-809(Sep 1975). (In French)

The low temperature magnetic properties of $TbFeO_3$ have been studied as a function of an applied field along the x and y crystallographic directions. Differential susceptibility measurements along the x axis performed at various temperatures lead to experimental phase diagrams of two types of samples which are distinguished by the presence or absence of an intermediate ferromagnetic phase before the final antiferromagnetic ordering around 3K. A theoretical treatment taking into account a possible gradual rotation of the Fe system in the xOz plane, has been developed and gives a quantitative interpretation of the experimental results when previously determined values of the Fe-Tb and Tb-Tb interactions are used. The magnetization measurements along the y direction at 1.1K show two transitions occurring for quite different values of the applied field. A qualitative explanation of this behavior can be given when one introduces an intermediate cooperative structure F_xF_y associated with a rotation of the Fe system from G_xF_z to G_zF_x. (FR)

23670 THERMAL EXPANSION ANOMALY AND THERMAL CONDUCTIVITY OF U_3O_8. Schulz, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Rev. Int. Hautes Temp. Refract.; 12: No. 2, 132-134(Apr 1975). (In German)

From 4th European Conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

The anomaly in the thermal expansion of U_3O_8 and results of the thermal conductivity of this compound are described. U_3O_8 powder heat treated at 1,223°K was consolidated by pressing and sintering in air at 1,223 and 1,373°K to a density of 66% and 80.8% TD. For $UO_{2.63}$ the thermal linear expansion was measured at 293 to 1,063°K in pressing direction and normal to it, while for $UO_{2.67}$ measurements were done parallel to the pressing direction. The curves of the linear thermal expansion from 373 to 623°K show negative values and above positive for the three curves. The results are related to known data of phase-transition-temperatures of the orthorhombic U_3O_8. Measurements of the thermal conductivity were done on $UO_{2.67}$. The values of the thermal conductivity of $UO_{2.67}$ (corrected to zero porosity) show a very slight temperature dependence, they are about three times lower than those of the stoichiometric uranium dioxide in the same temperature range. (FR)

23671 ZIRCONIA, A REFRACTORY MATERIAL. Applications of the Electrical Properties. Anthony, A. M. (Centre National de la Recherche Scientifique, 45–Orleans-la-Source (France). Centre de Recherches sur la Physique des Hautes Temperatures). Ind. Ceram.; No. 686, 483-487(Jul 1975). (In French)

The study of zirconia structure and electrical properties explains its utilization at high temperature (2000°C; heating elements of furnaces) and medium temperature (1000°C; oxygen gages, oxygen pumps, fuel cells). (FR)

23672 EFFECT OF SINTERING ATMOSPHERE ON THE DENSITY OF URANIUM DIOXIDE PELLETS. Stuart, W. I.; Adams, R. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Mater.; 58: No. 2, 201-204(Nov 1975).

UO_2 pellets were sintered in flowing H_2–N_2–H_2O gas mixtures at temperatures between 1000 and 1300°C. Sintered density increased with increasing ratio R = partial pressure H_2O/partial pressure H_2. The results provide a method of producing dense stoichiometric UO_2 pellets by means of a single-stage sintering process. (NL)

23673 CARBON DIFFUSION IN HYPERSTOICHIOMETRIC URANIUM CARBIDE. Murch, G. E. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). J. Nucl. Mater.; 58: No. 2, 244-245(Nov 1975).

Recently, a model was proposed by Sarian for the analysis of carbon diffusion data in UC_x. For hyperstoichiometric carbide the diffusion mechanism was assumed to be by way of single carbon atoms migrating from doubly occupied sites to single occupied sites. This diffusion model was later discussed by the present author and Sarian's equation for the diffusion was modified to include a further term called the path probability. However, even this modified equation is still nonetheless incomplete. The purpose of the present note is to correct this inadequacy. (NL)

23674 STRUCTURE OF β-U_2N_3. Masaki, N.; Tagawa, H. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan). J. Nucl. Mater.; 58: No. 2, 241-243 (Nov 1975).

It is reported by Vaughan that the structure of β-U_2N_3 is of the La_2O_3-type based on x-ray powder diffraction data. However, the exact value of the structural parameter for nitrogen atoms has not been determined because of the small x-ray scattering power of nitrogen compared to uranium. The present study has been made with the neutron and x-ray powder diffraction method at room temperature to determine the crystal structure of β-U_2N_3. (NL)

23675 ELECTRICAL RESISTIVITY AND LATTICE PARAMETER OF URANIUM MONOCARBIDE. Matsui, H.; Sakanishi, K.; Inagaki, M.; Aoyama, H.; Kirihara, T. (Nagoya Univ. (Japan). Faculty of Engineering). J. Nucl. Mater.; 57: No. 1, 93-97(Jul 1975).

The resistivity dependence of as-cast and annealed UC on temperature (77-300 K) as well as the C/U ratio have been investigated experimentally. Additionally, lattice constants of UC have

been measured in its nonstoichiometric regions. Estimated values of the electrical resistivity of stoichiometric UC (annealed at 1500°C for 3 h) were (10 ± 2) μΩ·cm at liquid-nitrogen temperature and (34 ± 3) μΩ·cm at room temperature, and the value of the lattice constant was (4.958 ± 0.001) A at room temperature. It was also estimated that 1 at% of carbon vacancies in UC_{1-x} and oversaturated carbon interstitials in UC_{1+x} result in resistivity increases pf (12 ± 2) μΩ·cm and 6 μΩ·cm, respectively. A very narrow nonstoichiometric region was observed in UC at 1500°C. It might lie between $UC_{0.98}$ and $UC_{1.01}$. (NL)

23676 URANIUM CARBIDE: THERMAL DIFFUSIVITY, THERMAL CONDUCTIVITY AND SPECTRAL EMISSIVITY AT HIGH TEMPERATURES. de Coninck, R.; van Lierde, W.; Gijs, A. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). J. Nucl. Mater.; 57: No. 1, 69-76(Jul 1975).

The thermal diffusivity, thermal conductivity, and spectral emissivity at 0.65 μm of uranium carbide have been measured with the aid of a modulated electron-beam apparatus. For hypostoichiometric samples, a reversible, time-dependent oxidation-reduction of the surface interfered with the measurements between 1100 and 1400°C, without affecting the results. Expressions are derived representing the thermal diffusivity, thermal conductivity and spectral emissivity for stoichiometric and for slightly hypo- and hyperstoichiometric uranium carbide. (NL)

23677 THEORETICAL ANALYSIS OF KNOCK-OUT RELEASE OF FISSION PRODUCTS FROM NUCLEAR FUELS. Yamagishi, S. (Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken, Japan). J. Nucl. Mater.; 57: No. 1, 56-68(Jul 1975).

The knock-out release of fission products is studied theoretically. The general equations of knock-out release are derived, assuming that a fission fragment passing through the surface of nuclear fuels knocks out a local region of the surface with an effective thickness and an effective cross-sectional area. Using these equations, the knock-out release of fission gases is calculated for various cases. The conditions under which the knock-out coefficients (the average number of uranium atoms knocked out by one fission fragment) is obtainable are clarified by experiments on the knock-out release of fission gases. A method of determining the effective thickness and the effective cross-sectional area of a knock-out region is proposed. (NL)

23678 BEHAVIOR OF FISSION-PRODUCT BARIUM AND STRONTIUM IN IRRADIATED UO_2. Friskney, C. A.; Simpson, K. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). J. Nucl. Mater.; 57: No. 1, 121-122 (Jul 1975).

Some observations on the disposition of barium and strontium fission products in the UO_2 kernals of irradiated HTR fuel particles are reported. The particles were examined by electron-probe microanalysis (EPMA) and by a nod-dispersive x-ray analyzing attachment to a scanning electron microscope (NDA). In the fuel-temperature range 1200-1700°C it is found that there is a marked difference in the behavior of barium and strontium in UO_2. (NL)

23679 THERMOLUMINESCENCE AND ESR OF γ-RAY AND PILE IRRADIATED NATURAL BARITE. Gupta, N. M.; Luthra, J. M.; Sastry, M. D. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). J. Lumin.; 10: No. 5, 305-312(Jun 1975).

Thermoluminescence (TL) and electron spin resonance (ESR) studies of γ-ray and pile-irradiated natural barite have led to the identification of centers which act as electron or hole traps. Intense pile irradiation seems to help the formation of the $S_2O_3^-$ radical. The presence of cation vacancies, as indicated by TL > low curves, makes pile-irradiated (>10^{18} n cm^{-2}) samples "immune" to further γ-irradiations as far as TL and ESR are concerned. (NL)

23680 THERMAL DIFFUSIVITY OF SOLID SOLUTIONS OF ZIRCONIUM AND NIOBIUM MONOCARBIDES AT HIGH TEMPERATURES. Neshpor, V. S.; Fridlender, B. A.; Ordan'yan, S. S.; Grishchenko, V. I. (Inst. of Tech., Leningrad). High Temp. (USSR) (Engl. Transl.); 12: No. 5, 992-995(1974).

Translated from Teplofiz. Vys. Temp.; 12: No. 5, 1125-1128 (1974).

The thermal diffusivity of ZrC-NbC alloys was measured by the method of plane temperature waves in electron-beam heated samples under vacuum. A noted decrease in thermal diffusivity and thermal conductivity with an increase of Nb content was attributed to scattering of phonons and conductivity electrons at lattice distortions and to the isotope effect. Upon a decrease in C vacancy concentration the isotherms of the thermal diffusivity shifts toward the less-heat conducting ZrC. (JRD)

23681 SPATIAL DISTRIBUTION OF THE OSCILLATION DENSITY OF ELECTRON-HOLE PAIRS DURING BOMBARDMENT OF SILICON CARBIDE WITH ELECTRONS OF ENERGIES UP TO 20 keV. Makarov, V. V. (Leningrad Polytechnic Inst.). Fiz. Tekh. Poluprov.; 9: No. 6, 1098-1101(Jun 1975).

The surface-barrier diode method is used to study the spatial distribution n(x) of the oscillation density of electron–hole pairs in silicon carbide crystals. This method consists in analysis of the volt–ampere characteristics of the current of nonequilibrium carriers arising in a surface-barrier diode prepared by deposition of a thin metal film on the semiconductor being studied, when the diode is irradiated through the film. The experimental data in this case could be readily approximated by the Gaussian function $n(x) = n_m \exp[-(x-x_m)^2 a^{-2}]$. The dependence of the parameters n_m, x_m, and a on the energy E_0 of the bombarding electrons was determined, along with the link between maximal electron free path and the distribution parameters. A method suitable for computing n(x) for other semiconductors in the $E_0 = 1 - 20$ kev energy range is suggested. (JPRS)

23682 THERMODYNAMIC PROPERTIES OF NON-STOICHIOMETRIC URANIUM OXIDES. Marchidan, D. I.; Tanasescu, S. (Centre de Chimie Physique, Bucharest). Rev. Roum. Chim.; 20: No. 11-12, 1365-1370(1975). (In French).

The electromotive forces were measured with a solid electrolyte galvanic battery in order to obtain thermodynamic data for uranium oxides between UO_2 and U_3O_8 in the temperature interval from 1073 to 1373°K. The partially molar and integral free energies, enthalpies, and entropies of oxygen were measured. The equilibrium partial pressures of oxygen were also measured. The variation of these properties were studied as a function of the O/U atomic ratio and the temperature. The results obtained show different aspects of the phase relations between the non-stoichiometric oxides which are stable at high temperature. (tr-auth)

23683 NITROGEN IMPLANTATION IN SiC: LATTICE DISORDER AND FOREIGN-ATOM LOCATION STUDIES. Campbell, A. B. (McMaster Univ., Hamilton, Ont.); Shewchun, J.; Thompson, D. A.; Davies, J. A.; Mitchell, J. B. pp 291-298 of Ion Implantation in Semiconductors. Namba, S. (ed.). New York; Plenum Publishing Corp. ([nd]).

The implantation behavior of 25 to 80 keV nitrogen in alpha-SiC was investigated for doses of 2 x 10^{15} and 2 x 10^{16} N atoms/cm^2 as a function of implantation temperature (20 to 450°C) and subsequent anneal treatments up to 1485°C. Backscattering yield measurements (using a 2-MeV helium beam) and $^{15}N(p,alpha)$ nuclear reaction yield measurements (using a 1-MeV proton beam) were used to study the amount of residual damage in the crystal and the lattice location of the implanted nitrogen atoms, respectively. Results indicate the advantage of high temperature implantation in producing a high "substitutional" fraction (approximately 70 percent) and a minimum damage level. In the 450°C implants, a maximum substitutional nitrogen concentration of approximately 1 x $10^{21}/cm^3$ was obtained. Evidence for an anomalous "inverse annealing" stage at approximately 800°C is observed for the 350 and 450°C implants, with the residual damage level increasing markedly and the "substitutional" nitrogen fraction decreasing to around the 50 percent level. (auth)

23684 INTERFACES IN CERAMIC NUCLEAR FUELS. Reeve, K. D. (Australian Atomic Energy Commission Research Establishment, Sydney). pp 331-368 of Surfaces and Interfaces of Glass and Ceramics. Frechette, V. D. (ed.). New York; Plenum Publishing Corp. ([nd]).

Internal interfaces in all-ceramic dispersion fuels (such as these for HTGRs) are discussed for two classes: BeO-based dispersions, and coated particles for graphite-based fuels. The following points are made: (1) The strength of a two-phase dispersion is controlled by the weaker dispersed phase bonded to the matrix. (2) Differential expansion between two phases can be controlled by an intermediate buffer zone of low density. (3) A thin ceramic coating should be in compression. (4) Chemical reaction between coating and substrate and mass transfer in service should be minimized. The problems of the nuclear fuel designer are to develop coatings for fission product retention, and to produce radiation-resistant interfaces. 44 references, 18 figures. (DLC)

23685 INVESTIGATION INTO THE STRUCTURE AND COMPOSITION OF COATINGS PRODUCED BY GAS-POWDER BORON CARBIDE SURFACING. Shutov, I. D.; Dobrovol'skij, A. G.; Strashinskaya, L. V.; Dem'yanchuk, A. S.; Korzhova, V. Ya. (Kievskij Inzhenerno-Stroitel'nyj Inst., Cherkassy (Ukrainian SSR). Obshchetekhnicheskij Fakul'tet; AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya; AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki). Porosh. Metall., Akad. Nauk Ukr. SSR; No. 8, 50-53(Aug 1974). (In Russian)

For English translation see the journal Sov. Powder Metall. Met. Ceram.

Results of a study of structure and of phase, chemical, and layer spectral analysis of coatings obtained by gas-powder sur-

facing with boron carbide and mixed boron carbide and iron powders are reported. The surface layers consist of dendritic and eutectic zones, including the phases FeB, Fe_2B, $Fe_{23}(C, B)_6$, $Fe_3(C, B)$, and α Fe. Analysis of the technology of the process and the structure of the coatings indicates the expediency of coating with mixtures containing 10% boron carbide and 90% iron powder. (tr-auth)

23686 PRODUCTION OF COMPLEX ZIRCONIUM-TUNGSTEN CARBIDE ON SEMI-COMMERCIAL SCALE. Grebenkina, V. L.; Karasev, A. I.; Pedanov, L. G.; Shumilova, R. G. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Porosh. Metall., Akad. Nauk Ukr. SSR; No. 7, 80-83(Jul 1973). (In Russian)

For English translation see the journal Sov. Powder Metall. Met. Ceram.

Conditions for preparing complex Zr-W carbides on a semi-commercial scale were studied. The optimum regime for obtaining a solid solution with the highest combined carbon content was sintering of a mixture of the carbides with carbon in a Tamman furnace at 2300°C for 2 hr in a hydrogen atmosphere. (tr-auth)

23687 ABRASIVE WEAR-RESISTANCE AND RUPTURE CHARACTER OF TITANIUM- AND ZIRCONIUM BORIDES SURFACE. Dan'kin, A. A.; Svetlopolyanskaya, T. P.; Oreshkin, V. D.; Svetlopolyanskij, V. I. Porosh. Metall., Akad. Nauk Ukr. SSR; No. 7, 88-92(Jul 1974). (In Russian)

For English translation see the journal Sov. Powder Metall. Met. Ceram.

The abrasive erosion rate of Ti and Zr borides was analyzed as a function of the angle of attack with a constant rate of abrasive current. The nature of the damage to the surface layer of the sample was examined. The phenomena observed are interpreted on the basis of a configuration model of the substance. The wear resistance of Ti and Zr borides was compared with that of steel X18H10T. (tr-auth)

23688 THERMODYNAMIC PROPERTIES OF CHROMIUM TELLURIDE Cr_2Te_3. Goncharuk, L. V.; Lukashenko, G. M. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Porosh. Metall., Akad. Nauk Ukr. SSR; No. 9, 45-47(Sep 1974). (In Russian)

For English translation see the journal Sov. Powder Metall. Met. Ceram.

23689 PECULIARITIES OF THE PROCESS OF COMBINED HYDROGEN REDUCTION OF IRON AND TUNGSTEN OXIDES. Radomysel'skij, I. D.; Barshchevskaya, L. F.; Vlasyuk, R. Z. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Porosh. Metall., Akad. Nauk Ukr. SSR; No. 10, 14-20(Oct 1974). (In Russian)

For English translation see the journal Sov. Powder. Metall. Met. Ceram.

The phase composition of the solid products of reduction of a mixture of Fe and W oxides and the chemical compound Fe_2WO_6 formed when the mixture is calcined in air were studied by x-ray analysis. A characteristic feature of the simultaneous reduction of Fe and W oxides is their interaction and formation of complex oxides of the $FeWO_4$ type with spinel structure and further reduction of it. In the reduction of a mechanical mixture of Fe and W oxides and their compounds, an analogy was observed in the process, which was confirmed by the kinetics of the latter and the same value of the apparent activation energy. A mechanism for the reduction of a mixture of Fe and W oxides and the chemical compounds is presented. (tr-auth)

23690 SUPERCONDUCTIVITY OF THE COMPOUNDS PbTe AND PbSe UNDER HIGH PRESSURE. Brandt, N.B.; Gitsu, D.V.; Popovich, N.S.; Sidorov, V.I.; Chudinov, S.M. (Moscow State University). JETP Lett. 22: No. 4, 104-105 (20 Aug 1975).

Superconductivity was observed in the high-pressure phases of the compounds PbTe and PbSe at pressure $p \simeq 175$ and $\simeq 300$ kbar, with superconducting-transition temperatures 8 and 6.5°K, respectively. (auth)

23691 INVESTIGATION OF NEGATIVE MAGNETORESISTANCE OF *n*-TYPE InP. Emel'yanenko, O.V.; Lagunova, T.S.; Masagutov, K.G.; Nasledov, D.N.; Nedeoglo, D.D. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Semicond. 9: No. 8, 1001-1004 (Aug 1975).

An investigation was made of the negative magnetoresistance of *n*-type InP crystals with an electron density in the range $n = 10^{15}$–10^{18} cm^{-3}. The results were explained satisfactorily by the scattering of electrons on localized spins. The magnetic moment μ^* of the scattering centers was $\sim 10\ \mu_B$ for $n \sim 10^{16}$ cm^{-3} and it increased with n. The negative magnetoresistance of crystals with $n \lesssim 5 \times 10^{16}$ cm^{-3} subjected to fields of $H < 3$–5 kOe was proportional to H^2. This quadratic region was not exhibited by the more heavily doped samples. The results were explained by the statistical nature of the value of μ^*. (auth)

23692 NEUTRON-DIFFRACTION STUDY OF UO_2: PARAMAGNETIC STATE. Lander, G.H.; Faber, J. Jr. (Argonne National Laboratory, Argonne, Illinois 60439); Freeman, A.J.; Desclaux, J.P. Phys. Rev. B 13: No. 3, 1177-1182 (1 Feb 1976).

The magnetic form factor of the induced moment in UO_2 has been measured in the paramagnetic state at $T = 64$ K with polarized neutrons in an applied field of 50 kOe. The theoretical form factor is derived with the tensor-operator method and the $\langle j_l \rangle$ integrals for U^{4+} derived from relativistic Dirac-Fock wave functions. Three models for the electronic state are considered: (i) the free-ion U^{4+} ground state, (ii) the $^3H_4$ Γ_3 crystal-field ground state, and (iii) the Rahman and Runciman mixed-J Γ_3 ground state. The calculation of the magnetic scattering in the presence of intermediate coupling and J mixing is discussed. Whereas the experimental data are unable to distinguish between the small angular differences predicted for the three models, the radial dependence of the magnetic scattering is found to be in good agreement with theory and confirms the validity of the Dirac-Fock $\langle j_l \rangle$ integrals. (auth)

23693 EFFECT OF LATTICE INSTABILITY ON SUPERCONDUCTIVITY IN SODIUM TUNGSTEN BRONZE. Ngai, K.L. (Naval Research Laboratory, Washington, D.C. 20375); Silberglitt, R. Phys. Rev. B 13: No. 3, 1032-1039 (1 Feb 1976).

The effect of lattice instability on the electronic properties of the tungsten bronzes, $M_xWO_3 (0 < x < 1)$, is considered. A model of the free energy which describes the various phases as local minima in configuration space is shown to provide a basis for understanding the structures observed and transformations between them where M is an alkali metal. For the case of Na_xWO_3, the effect on the superconducting transition temperature of a phonon which is assumed to soften as a function of x is explicitly calculated. Tunneling between the local free-energy minima is assisted by this soft phonon. Good agreement is obtained with recent experimental observations of a dramatic increase in T_c as x decreases and approaches the critical value for transition between the superconducting and semiconducting tetragonal phases. Noteworthy features of this work are that the structural transformation does not correspond to a simple condensation of the soft phonon, and also that the phonon softening and configurational tunneling are considered simultaneously. (auth)

23694 NEUTRON-DIFFRACTION STUDY OF UO_2: OBSERVATION OF AN INTERNAL DISTORTION. Faber, J. Jr.; Lander, G.H. (Argonne National Laboratory, Argonne, Illinois 60439); Cooper, B.R. Phys. Rev. Lett. 35: No. 26, 1770-1773 (29 Dec 1975).

We have deduced from measurements of the neutron elastic cross section that below the Néel temperature (T_N) the oxygen atoms in UO_2 are shifted from their ideal fluorite positions. We find quantitative agreement with experiment by assuming a rearrangement (internal shear deformation with amplitude 0.014 Å) of the oxygen sublattice. The dominance of this deformation mode in the spin-lattice interactions suggests the presence of a noncollinear magnetic structure in UO_2. (auth)

23695 RADIATIVE RECOMBINATION IN MELT-GROWN AND CD—IMPLANTED $CuInSe_2$. Yu, P.W. (Department of Physics, University of Dayton, Dayton, Ohio 45469). J. Appl. Phys. 47: No. 2, 677-684 (Feb 1976).

The behavior of the low-temperature emission spectra of melt-grown *p*-type and Cd-implanted *n*-type $CuInSe_2$ with changes in temperature and excitation intensity have been investigated. Broad-band emission was dominant in the melt-grown crystals grown under an excess Se atmosphere. Generally, the broad-band peak was observed to occur at ~0.94–0.95 eV, all peaks lying in the broad range of energy of ~0.87–0.95 eV at 4.2 °K. The band was observed to shift to higher energy as the excitation intensity or temperature was increased, which implies that the band is due to a donor-acceptor pair mechanism. The spectral characteristics are explained by the presence of an acceptor level ($E_A = 85 \pm 2$ meV) and a donor level ($E_D = 65 \pm 2$ meV) and by compensation-dependent band shift in the *p*-type crystals. Acceptors and donors responsible for the pair band appear to be Cu and Se vacancies. The change in the peak energy of the band per decade of excitation intensity was found to be in the range 4–25 meV at 4.2 °K. The shift of the broad-band peak to lower energies and the increase in the magnitude of the energy shift due to the excitation intensity are consistent with high doping and compensation. A broad emission band was also observed in Cd-implanted crystals at low temperatures. The temperature dependence of the broad band in these crystals was opposite to that of the *p*-type crystals, the peak shifting to lower energy with an increase in temperature. (auth)

23696 HELIUM MIGRATION IN BOROGERMANATE GLASSES. Shelby, J. E. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 10, 4510-4514(Oct 1975).

Helium permeation, diffusion, and solubility were measured in a series of B_2O_3–GeO_2 glasses. All three parameters exhibit negative deviations from additivity at all compositions. Since inter-

mediate glasses in this series also always have a lower free volume than would be predicted from additivity, it is postulated that the deviations observed in the helium mobility and solubility are primarily due to an increase in the compactness of the glass network. This conclusion is consistent with the results of several other recent studies of gas mobility in glass. (auth)

23697 OUTLINE OF THE CRYSTAL-STRUCTURE OF $Bi_2Mo_2O_9$. van den Elzen, A. F.; Riech, G. D. (Eindhoven Univ. of Tech., Netherlands). Mater. Res. Bull.; 10: No. 11, 1163-1168 (Nov 1975).

An outline of the structure of the catalyzer component $Bi_2Mo_2O_9$ has been determined from x-ray powder diffractometer diagrams. The space group is P^2 1/n (equals P^2 1/c) with cell constants: a equals 11.946 (2) A, b equals 10.795 (2) A, c equals 11.876 (2) A and beta equals 90.15 (2)°. There are eight formula units per cell. The positions of the metal-ions could directly be derived from the intensities of the strongest reflections. With difference terms calculated from 19 strong reflections a DELTA F-synthesis was calculated, which revealed the approximate positions of the O^{2-}-ions. From packing considerations it was apparent that of 9 O^{2-}-ions one is only coordinated by Bi^{3+} and that Mo^{6+} must be tetrahedrally surrounded by O^{2-}. These tetrahedra may be strongly distorted. The structure is not related to the scheelite-structure as has been assumed. (auth)

23698 PHASE RELATIONS IN THE OXYGEN RICH REGION OF THE Cr-W-O TERNARY SYSTEM. Ekstroem, T. (Univ. of Stockholm); Tilley, R. J. D. Mater. Res. Bull.; 10: No. 11, 1175-1180 (Nov 1975).

The phases occurring in the ternary Cr-W-O system at 1370°K have been determined using x-ray diffraction and electron and optical microscopy. It was found that at this temperature no Cr enters WO_3 or the other tungsten oxides and no ternary CS phases appear to form. Instead, the Cr reacts to form one or two ternary rutile phases and equilibrium lies between them and the appropriate binary tungsten oxide. The compositions of these ternary oxides are Cr_2WO_6 and a previously unreported phase $CrWO_4$. No extended homogeneity ranges have been detected for these oxides. A phase diagram summarizes the results which are also considered in the light of the formation of crystallographic shear phases in tungsten oxides. (auth)

23699 STUDY OF SOME $Ln_2Ge_2O_7$ COMPOUNDS (Ln equals La, Nd, Sm, Eu, Gd). Jouhet-Vetter, G.; Queyroux, F. (ESPCI, Laboratoire de Chimie du Solide Mineral, Paris). Mater. Res. Bull.; 10: No. 11, 1201-1204 (Nov 1975).

Some $Ln_2Ge_2O_7$ compounds (Ln equals La, Nd, Sm, Eu, Gd) have been reinvestigated. A preliminary crystallographic study shows that the compounds $Nd_2Ge_2O_7$ and $Sm_2Ge_2O_7$ belong to a new structural family. Tetragonal form has also been found for $Gd_2Ge_2O_7$ below 1250°C. (auth)

23700 PREPARATION AND CELL PARAMETERS OF NEW RARE-EARTH TUNGSTATES $R_{10}W_{22}O_{81}$ (R equals La, Ce, Pr AND Nd). Yoshimura, M.; Morikawa, H.; Miyake, M. (Tokyo Inst. of Tech.). Mater. Res. Bull.; 10: No. 11, 1221-1224 (Nov 1975).

The stoichiometry and cell parameters of the compounds reported previously as $2R_2O_3 \cdot 9WO_3$ were studied with single crystals and sintered samples. They seem to have the title composition and crystallize in an orthorhombic symmetry. Pbcn with Z equals 2. The cell parameters are a equals 3.877A, b equals 35.971A and c equals 21.846A for the Nd compound. Cell volumes of these compounds vary linearly with the cube of ionic radius. (auth)

23701 NEW CATALYSTS FOR THE HIGH PRESSURE SYNTHESIS OF CUBIC BN. Koyayashi, T.; Susa, K.; Taniguchi, S. (Hitachi, Ltd., Tokyo). Mater. Res. Bull.; 10: No. 11, 1231-1236 (Nov 1975).

The catalytic effect of water on the high pressure synthesis of cubic BN from hexagonal BN is studied in further detail. An amorphous substance is found to coexist with cubic BN thus prepared and is tentatively identified as anhydrous ammonium borate. The idea that a melt of ammonium borate which is formed by the reaction of hexagonal BN and water at high pressures and temperatures might act as a flux for the conversion from hexagonal BN to cubic BN, leads to the discovery of new catalysts such as urea, ammonium borate, and ammonium nitrate. It is also found that cubic BN can be synthesized from boron and urea or ammonium nitrate under the same pressures and temperatures. The results open more efficient ways of synthesizing cubic BN. (auth)

23702 PREPARATION AND PROPERTIES OF BERYLLIUM DIPHOSPHIDE. Brice, J. F.; Gerardin, R.; Zanne, M.; Gleitzer, C.; Aubry, J. (Univ., Nancy). Mater. Res. Bull.; 10: No. 11, 1237-1242 (Nov 1975).

The compound BeP_2 can be obtained by direct action of phosphor on beryllium metal at 800-1000°C, and by removal of arsenic with phosphor in the diarsenide $BeAs_2$. BeP_2 is a non hygroscopic brown-red powder. The X rays diffraction provide evidence for a quadratic cell with a equals 7.08 A and c equals 15.06 A. The atomic stacking is diamond type. (auth)

23703 SOLID SOLUTIONS IN THE Y_2O_3–Pr_2O_3 SYSTEM, AND THEIR MORPHOTROPY. Tikhonov, P. A.; Merezhinskii, K. Yu.; Kuznetsov, A. K. (Inst. of Silicate Chemistry, Leningrad). Dokl. Phys. Chem. (Engl. Transl.); 222: No. 4-6, 650-652 (Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 4, 1387-1389 (Jun 1975).

The subsolidus region of the phase diagram of the Y_2O_3–Pr_2O_3 system was studied in the temperature range 1250-1800°C. (LK)

Metals and Alloys

23704 (ERDA-55) MATERIALS SCIENCES PROGRAMS, FY 1975. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Physical Research). Jul 1975. 151p. Dep. NTIS $6.75.

A compilation of ERDA materials sciences programs is presented. The compilation is divided into sections in which projects are listed and funding levels are summarized. An index is included. (JRD)

Corrosion and Erosion

Refer also to abstracts 23666, 25108, 25170, 25207, 25258, and 25275.

23705 (RD/B/N-3350) NITRIDING OF SOLUTION TREATED A1S1 TYPE 316 STAINLESS STEEL IN AMMONIA–HYDROGEN MIXTURES. Tyfield, S. P.; Mackway, J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1975. 27p. Dep. NTIS (US Sales Only) $4.00.

Nitrogen will be present as a minor impurity in the helium coolant of an HTR and in the argon gas of a CFR. Nitriding of structural materials may occur which modifies their mechanical properties. In a previous attempt to interpret the mechanism of nitriding 316 stainless steel, the accelerated kinetics of nitriding in ammonia were studied. The results revealed that the nitrogen potential in ammonia was sufficient to form iron nitrides, which are not produced in nitrogen. Furthermore, the nitrogen potential of dissociated ammonia varied with flowrate and temperature, however the gas phase nitrogen potential may be controlled by the use of ammonia-hydrogen mixtures. A study is described of the nitriding of 316 stainless steel in NH_3/H_2 mixtures between 500 and 800°C to examine the application of the rate data, so obtained, to nitriding in molecular nitrogen. The rate of nitriding in NH_3-H_2 was found to be parabolic, at nitrogen potentials insufficient to produce surface iron nitrides. The rate determining process is interpreted to be dependent on both chromium nitride precipitation and nitrogen diffusion. It is concluded that the kinetics of nitriding 316 stainless steel in molecular nitrogen between 500 and 800°C are not reliably predicted on the basis of accelerated kinetic results produced either by increasing the nitrogen potential by the use of NH_3/H_2 mixtures or by elevating the temperature as reported elsewhere. (auth)

23706 INCOMPATIBILITY BETWEEN ZIRCALOY-2 AND INCONEL X-750 DURING TEMPERATURE TRANSIENTS. Warren, M. R.; Roerbo, K.; Adolph, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). J. Nucl. Mater.; 58: No. 2, 185-188 (Nov 1975).

The incompatibility of Zircaloy-2 and Inconel X-750 has been investigated between 1000°C and 1200°C (1200°C being the currently allowable maximum temperature in the acceptance criteria for ECCS for water reactors). It has been found for the temperatures of 1000°C and 1200°C that oxide thicknesses of 2 and 30 μm respectively protect the Zircaloy-2 against attack by Inconel X-750. (NL)

23707 EFFECT OF HYDROGEN CONCENTRATION AND COOLING RATE ON HYDRIDE PRECIPITATION IN α-ZIRCONIUM. Nath, B.; Lorimer, G. W.; Ridley, N. (Manchester Univ. (UK). Dept. of Metallurgy). J. Nucl. Mater.; 58: No. 2, 153-162 (Nov 1975).

Reactor-grade zirconium specimens containing from 50 to 640 ppm hydrogen have been cooled from solution-treatment temperatures at different rates by water-quenching, oil-quenching, air-cooling and furnace-cooling. Optical and electron metallography have shown that the average size of the hydrides, the proportion of the hydrides located at grain boundaries, and the proportion of the equilibrium δ-hydride increased as the hydrogen concen-

tration was increased and/or the rate of cooling was decreased. The precipitate distributions and relative amounts of the γ and δ hydrides observed can be explained in terms of nucleation theory. (NL)

23708 EFFECTS OF MOLYBDENUM ADDITIONS ON THE CORROSION RESISTANCE OF STAINLESS STEELS IN INORGANIC AQUEOUS SOLUTIONS AND ORGANIC MEDIA (A REVIEW). Charbonnier, J. C. (Institut de Recherches de la Siderurgie Francaise (IRSID), 78–Saint-Germain-en-Laye). Metaux (Corros.-Ind.); 51: No. 598, 201-222(Jun 1975). (In French)

The effects of molybdenum additions on the corrosion resistance of austenitic and ferritic stainless steels are reviewed. The following types of corrosion are considered: uniform attack in inorganic and organic acids and pitting and crevice corrosion in chloride media. The survey has been conducted with particular emphasis on the recent works. The different hypotheses which have been suggested in order to clarify the role of the molybdenum additions on the improvement of the corrosion resistance of stainless steels are analyzed and discussed. (FR)

23709 MECHANISMS OF STRESS GENERATION AND RELAXATION DURING THE OXIDATION OF U ALLOYS. Cathcart, J. V.; Petersen, G. F. (Oak Ridge National Lab., TN). vp of Stress Effects and the Oxidation of Metals. Cathcart, J. V. (ed.). New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1975).

Very large stresses arise in the oxide scales during the oxidation of a variety of U alloys. The stress generation is related to the mode of diffusion in the oxide and to the oxide morphology. Several stress relaxation mechanisms are discussed. These include the creep of both oxide and substrate, cracking of the oxide, and a vacancy flow mechanism similar to Nabarro–Herring creep. Specific examples of these various phenomena are drawn from results obtained during the oxidation of U–Nb, U–Mo, and U–Nb–Zr alloys. (auth)

23710 OXIDATION CHARACTERISTICS OF Ta–10W AND Ta–10W–2.5 Hf ALLOYS. Pawel, R. E.; Campbell, J. J. (Oak Ridge National Lab., TN). vp of Stress Effects and the Oxidation of Metals. Cathcart, J.V. (ed.). New York; American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1975).

Early stages of oxidation of the alloys Ta–10W and T-222 were studied at 500 to 800°C in dry oxygen at atmospheric pressure. Both alloys exhibited a period of protective oxidation followed by an accelerating rate due, at the lower temperatures, to the initiation and lateral growth of high-rate regions consisting of porous, nonprotective oxide. At the higher temperatures, the oxide film was more resistant to this form of breakdown which resulted in comparatively longer periods of protection. Measurements of the strain induced in specimens of these alloys during oxidation were made by the flexure technique. The kinetics of flexure in the protective stage of oxidation over the above temperature range were determined and compared to the kinetics of oxidation. While high stresses undoubtedly existed in the oxide layers themselves, the major contributor to flexure under these conditions was judged to be oxygen solution effects in the alloys. The experimental results are examined in terms of the kinetics of the reactions and of the morphologies of the reaction products for the individual alloys and for unalloyed tantalum. (auth)

23711 HIGH-TEMPERATURE CORROSION IN GAS TURBINES AND STEAM BOILERS BY FUEL IMPURITIES. IV. Evaluation of Silicon and Magnesium–Silicon as Corrosion Inhibitors. May, W. R.; Zetlmeisl, M. J.; Annand, R. R. (Petrolite Corp., St. Louis). J. Eng. Power; 96: No. 2, 124-128(Apr 1974).

The corrosion rates of Udimet 500 in a variety of sodium sulfate-silica-vanadium pentoxide and sodium sulfate-magnesium sulfate-silica-vanadium pentoxide slag compositions were measured electrochemically at temperatures up to 950°F. The weight ratios of the elements sodium, silicon, and magnesium to vanadium were defined for acceptable corrosion rates. A simple burner test for slag evaluation is described. Characteristics of slags produced by magnesium, silicon, and magnesium-silicon in conjunction with sodium sulfate and vanadium pentoxide are discussed. Results indicate that the magnesium-silicon combination produces a slag which is equally as low as magnesium in corrosivity and superior in slag characteristics. (Electr. Electron Abstr.)

23712 HYDROGEN INTERACTIONS WITH METALS. McLellan, R. B.; Harkins, C. G. (Rice Univ., Houston, Tex. (USA). Dept. of Mechanical Engineering). Mater. Sci. Eng.; 18: No. 1, 5-35(Mar 1975).

220 refs.

As ordinary hydrogen (99.985% $_1H^1$) becomes more important as a chemical fuel and as the heavier isotopes deuterium ($_1H^2$) and tritium ($_1H^3$) become more important as nuclear fusion fuels, the interactions with structural materials which must contain and transport hydrogen are of growing interest. Additional technologies contributing to this interest include hydrogen-fueled aerospace vehicles and the operation of materials in environments (such as sour gas petroleum wells) where thermal dissociation, catalytic dissociation or corrosion reactions provide hydrogen species at material surfaces. Other than the universally valid role of undating previous reviews, the purpose is the integration of information scattered over various sub-disciplines. In particular information obtained for physical chemical purpose has been combined with that obtained for its engineering implications. An attempt is made to correlate and interweave the material of this report so as to achieve some degree of balance and continuity. (auth)

23713 MOESSBAUER STUDY OF NITRIDED Fe–Mo AND Fe–Ti ALLOYS. Huffman, G. P.; Podgurski, H. H. (United States Steel Corp., Monroeville, PA). Acta Metall.; 23: No. 11, 1367-1379(1975).

^{57}Fe Moessbauer spectroscopy was employed in a study of the nitride phases generated in Fe–Mo and Fe–Ti alloys by gas-phase nitrogenation at temperatures from 400 to 600°C. The nitriding reactions were carried to a variety of nitrogen levels in numerous samples in which the degree of nitride dispersion was monitored by transmission electron microscopy, and ranged from nondetectable "particles" to fairly coarse platelets. From the relative areas under various satellite peaks in the Moessbauer spectra, the amounts of Mo or Ti and N in solution in the ferrite matrix could be determined at any stage of the nitriding reaction with reasonable accuracy. This information, coupled with knowledge of the nitrogen content as determined by sample weight gain, was sufficient to determine the composition of the nitride phases. At all levels of dispersion in both systems, the nitrides were found to have the stoichiometry MeN (Me equals Mo or Ti): no mixed metal nitrides containing Fe were detected. For some samples, satellite peaks arising from Fe nuclei which were nearest neighbors to N atoms contained in finely dispersed nitride phases could be identified and the relative areas of these peaks were processed to yield estimates of the approximate dimensions of the nitride particles and platelets. In the Fe–Mo system, a secondary Fe_2Mo phase was observed to form during H_2 reduction of alloys in which all molybdenum had been previously converted to nitride. The formation of Fe_2Mo also occurred during nitrogenation at 600°C but not at 500°C; this is explained in terms of concurrent dissolution of small MoN particles and growth of larger particles. (auth)

Preparation and Fabrication

Refer also to abstracts 23185, 23259, and 23260.

23714 (CONF-741040–P2, pp 114-124) ELECTRON BEAM WELDING OF STRUCTURAL AIRCRAFT COMPONENTS. Lofsten, A. (Grumman Aerospace Corp., Bethpage, NY). 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

Illustrations of how electron beam (EB) welding is currently being used in the manufacture of large complex aircraft structures are reviewed. Starting with a general description of the process, its advantages and limitations and then tracing the evolution of the equipment from the sizes being used as recently as 1969 having vacuum chamber capacities of approximately 64 cubic feet to those presently in production having chamber capacities over 2500 cubic feet. A parallel growth is outlined in the application of the process to larger structures, beginning with the basic data on mechanical properties obtained with small element testing, through the testing of sub and full scale structures. Welding parameters for some typical joints are presented together with the mechanical properties being achieved, including tensile, fatigue, and fracture toughness properties. Pre and post weld processing are described which are being used to optimize these properties. Several examples are reviewed including the Grumman F-14 wing center section and wing outer panels, Boeing Vertol UTTAS Helicopter swashplates, Messerschmitt-Bolkow-Blohm, Multi-Role Combat Aircraft wing center section and the Dassault Mirage G8A wing panel. The final portion describes general guidelines in designing structures for EB welding, with particular emphasis on accessibility for visual, x-ray, ultrasonic, and dye penetrant inspection.

23715 (ORNL/TM-5195) DIRECT BRAZING OF CERAMICS, GRAPHITE, AND REFRACTORY METALS. Canonico, D. A.; Cole, N. C.; Slaughter, G. M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 20p. Dep. NTIS $5.00.

ORNL has been instrumental in the development of brazing filler metals for joining ceramics, graphite, and refractory

metals for application at temperatures above 1000°C. The philosophy and techniques employed in the development of these alloys are presented. A number of compositions are discussed that have been satisfactorily used to braze ceramics, graphite, and refractory metals without a prior surface treatment. One alloy, Ti–25 percent Cr–21 percent V, has wet and flowed on aluminum oxide and graphite. Further, it has been utilized in making brazes between different combinations of the three subject materials. The excellent flowability of this alloy and alloys from the Ti–Zr–Ge system is evidenced by the presence of filler metal in the minute pores of the graphite and ceramics. (auth)

23716 METHOD FOR THE ELECTROLYTIC COATING OF URANIUM OR URANIUM ALLOY PARTS, AND PARTS THUS OBTAINED. (to Compagnie pour l'Etude et la Realisation de Combustibles Atomiques (CERCA), 75–Paris (France)). French Patent 2,231,771/A/. 29 May 1973. 10p. (In French)

A method, preceded by a surface treatment, is described for applying an electrolytic coating (e.g. of nickel) on uranium, or uranium alloy parts. This method is characterized in that the previous surface treatment comprises a chemical removal of grease in halogenated solvent bath (free from halogen ions) and an anodic scouring in a buffered aqueous solution of an acid free from halogen ions. The coating can be applied to fuel elements for nuclear industry, counter-weight for aeronautics and space industries, and to radiation shields. (FR)

23717 METHOD FOR PRODUCING SUPERCONDUCTING WIRE AND PRODUCTS OF THE SAME. Marancik, W. G.; Ormand, F. T. (to Airco, Inc.). US Patent 3,918,998. 11 Nov 1975. Filed date 19 Mar 1973. 8p.

A method is described for producing a composite superconducting wire including one or more strands of high-field Type II superconductor embedded in a conductive matrix of normal material. A composite body is prepared which includes a matrix in which are embedded one or more rods of a metal which is capable of forming a high-field Type II superconductor upon high temperature extruded to an intermediate diameter, and then is hot-drawn to a final diameter at temperatures exceeding about 100°C, by multiple passes through drawing dies, the composite being reduced in cross-sectional area approximately 15 to 20 percent per draw. In a preferred mode of practicing the invention, the rods comprise vanadium or niobium, with the matrix being respectively gallium–bronze or tin–bronze, and the superconductive strands being formed by high temperature diffusion of the gallium or tin into the rods subsequent to drawing. (Official Gazette)

23718 PREPARATION OF TARGETS OF Np, Pu, Am, Cm, AND Cf BY ELECTRODEPOSITION FOR ORGANIC SOLUTIONS. Muellen, G.; Aumann, D. C. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Radiochemie). Nucl. Instrum. Methods; 128: No. 3, 425-428(15 Oct 1975).

The preparation of thin and thick films of Np, Pu, Am, Cm and Cf by electrodeposition from organic solutions on metal foils is described. (NL)

23719 STUDY OF THE HOT WORKING AND THE RESISTANCE TO DEFORMATION OF THE U-0.2% V ALLOY BY TORSION TESTING BETWEEN 400 AND 800°C. Choquet, P.; Prunier, C. (CEA Centre d'Etudes de Valduc, 21–Is-sur-Tille (France)). J. Nucl. Mater.; 57: No. 1, 34-44(Jul 1975). (In French)

The resistance to deformation and the ductility of U–0.2wt%V alloy between 400 and 800°C has been measured by hot torsion for strain rates in the range 10^{-2}–3.6 sec^{-1}. In this temperature range, the alloy shows three successive distinct phases, orthorhombic α, tetragonal β, cubic γ, which behave differently. Two useful ranges were found for hot-working of this alloy: in the α range below 600°C and in the γ range. By means of plasticity theory the equivalence of hot torsion and hot tension has been established and a first rolling pass has been simulated. Some tensile tests between 600 and 800°C and a rolling test at 600°C have shown good justification for the transition from torsion to other modes of deformation. A metallographic study after fracture showed the existence of recrystallization in the α phase above 600°C and also in the γ phase, which explains the good hot workability. (NL)

23720 INHERITANCE OF FORGING TEXTURES IN Zr ALLOYS–PRACTICAL CONSEQUENCES. Decours, J.; Frenkel, J. M.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). J. Nucl. Mater.; 57: No. 1, 119-120(Jul 1975). (In French).

An investigation of the causes of excessive irregularities in the dimensions of cladding tubes forged from Zr metal and Zr-Nb alloy showed that this trouble was essentially due to heat treatment in the α, rather than the β phase. (NL)

23721 PRODUCTION OF TWO-COMPONENT FILMS OF VARIOUS COMPOSITIONS AND THEIR SUPERCONDUCTING PROPERTIES. Savitskii, E. M.; Efimov, Yu. V.; Sumarokov, V. N.; Pozin, A. I. pp 108-116 of Struktura i Svoistva Sverkhprodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Vacuum-deposition techniques were used to prepare 4000 to 10,000 Å thickness films of Nb–Sm, Zr–Sm, Ti–Sm, Pb–Sm, and Pb–La of various compositions. Phase diagrams were determined and measurements made of the superconducting transition temperature, T_c, in relation to film composition. A reduction in T_c is obtained with the solution of Sm in Nb and V. In the Pb–La system superconductivity is shown only by the Pb and La-base solid solutions, i.e. La < 0.15 or Pb < 0.2 at. %, respectively. Sm lowers the T_c of Pb, and in the region Sm 25 to 52.4 at.-% a new compound is reported with T_c = 6.7°K. Compounds in the Pb–Sm, Sm–Ti, and Sm–Zr systems are not superconductive at temperatures above 4.2°K. (Metals Abstr.)

23722 ANALYTIC PROFILE OF TUNGSTEN. Barboza, F. L. M. Bulletin No. 24. Rio de Janeiro; Ministerio das Minas e Energia (1973). 75p. (In Portuguese).

Information international in scope concerning W was compiled to assist the Brazilian government in setting policy with respect to the mineral substance and provide private industry with data on which to base investment decisions. Geology, technology, applications, production, consumption, trade, economics, the utilization of associated minerals and miscellaneous other topics are covered by means of test, tables, charts, maps, statistics, and flow sheets. Specifics of the Brazilian scene include the locations of mines and deposits, nature of deposits, volume of reserves, 1972 investments in exploration and exploitation, government incentives to investment and names of firms involved in the industry. Brazilian exporters of scheelite concentrate and the names and addresses of their customers are listed. (Metals Abstr.)

23723 ANALYTIC PROFILE OF BERYLLIUM. Dias, J. Bulletin No. 5. Rio de Janeiro; Ministerio das Minas e Energia (1973). 24p. (In Portuguese).

An analysis of the structure of the Be industry throughout the world and the present and future market for Be emphasizes the need for rational exploitation of Brazil's large reserves of beryl and the development, possibly with the aid of foreign capital and technology, of an industry for the production of beryllium oxide and Be metal. The nature of Brazilian pegmatites and the primitive conditions under which beryl is mined in Brazil are discussed; the locations of mining operations and the names of exporters of the ore are listed. The mineralogy, geology and methods of mechanical treatment of beryl, geochemical aspects of Be, and applications of Be metal are reviewed. (Metals Abstr.)

23724 ANALYTIC PROFILE OF VANADIUM. Done, G. A. Bulletin No. 25. Rio de Janeiro; Ministerio das Minas e Energia (1973). 20p. (In Portuguese).

Information of V and raw materials and products containing V was compiled to assist the Brazilian government in setting policy with respect to the mineral substance and provide private business with data on which to base investment decisions. Brazil produces no V and native occurrences of V are largely unequivalent. However, exploratory work is being conducted on some occurrences considered most likely to be economically workable deposits. The principal occurrences in Brazil are listed and the types of deposits and associated minerals are discussed. The geology of V-bearing ores, the technology of the industry, applications of V, world reserves, international production, consumption and trade statistics and economic aspects of the industry are considered. (Metals Abstr.)

23725 SINTERING OF TUNGSTEN-ALUMINIUM OXIDE CERMETS IN THE PRESENCE OF LIQUID PHASE. Storozh, B. D.; Kislyj, P. S. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Porosh. Metall., Akad. Nauk Ukr. SSR; No. 9, 27-32(Sep 1974). (In Russian)

For English translation see the journal Sov. Powder Metall. Met. Ceram.

Studies on the kinetics of solid and liquid-phase sintering of tungsten-aluminium oxide cermets are described. Based on the experimental results on shrinkage, the activation energy of mass transfer in sintering, in agreement with the laws of tungsten wetting by aluminum oxide and the interrelation of surface energy at the phase boundaries, and the change in microstructure, conclusions were drawn concerning the mechanism of mass transfer in sintering of tungsten-aluminum oxide cermets. (tr-auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 22701, 22727, 22983, 22984, 22986, 22987, 22989, 23192, 23659, 23663, 24300, 24633, 24650, 24972, 25144, 25259, and 25301.

23726 (AD/A-008935) THERMODYNAMICS OF CHEMICAL SPECIES IMPORTANT TO ROCKET TECHNOLOGY. Final Report, 1 July 1973–30 June 1974. Beckett, C. W. (National Bureau of Standards, Washington, D.C. (USA)). 1 Oct 1974. 200p. NTIS $7.00.

See also report dated 1 Jul 1973, AD–782028.

Using a subsecond-duration transient technique the specific heat, electrical resistivity, and hemispherical total emittance were simultaneously measured over the temperature range 1500 to 3000°K for some grades of graphite. Similar measurements were made on vanadium, and zirconium in the temperature range of 1500 to 2100°K. Melting points and radiance temperature (at 650 nm) are reported for zirconium and molybdenum. The temperature of the transition from the alpha-beta phase of zirconium and the energy difference of these phases was also measured using the subsecond duration transient technique. The products of the reaction of Fe(g) and Ox were investigated. A preliminary report on the study of the reaction of Ba(g) with vibrationally excited ozone is also presented. The dissociation energies of the scandium group and rare-earth gaseous monoxides are evaluated by reviewing the literature available on Knudsen effusion rates and mass-spectrometric data. A bibliography of the available literature on the spectroscopy of fluorides, oxides, and oxyfluorides belonging to the lanthanide series is given. (GRA)

23727 (AED-CONF-75-170-013) INFLUENCE OF PRECIPITATION DENSITY AND PARTICLE SIZE ON THE CONDUCTIVITY OF NbTi SUPERCONDUCTORS. Willbrand, J.; Schlump, W. (Krupp (Friedr.) G.m.b.H., Essen (F. R. Germany). Forschungsinstitut). 1975. 9p. (In German). INIS.

From general meeting of the Deutsche Gesellschaft fuer Metallkunde e.V.; Nuernberg, F. R. Germany (20 May 1975).

10 figs.; 9 refs. With abstract.

Comparison of the J_{cH} measurements with the electron-microscopically determined parameters sub-band width, precipitation density and particle size showed the following: there is only a moderate tendency to a relation between critical current density and sub-band diameter; sub-band diameters of about 25-40 nm, although necessary, are not a sufficient condition for high current densities. The precipitation density and the particle diameter are of greater importance. Volume densities between 10^{16} and 10^{17} cm^{-3} were measured corresponding to surface densities of about $10^{10}-10^{11}$ cm^{-2}. The particle size in wires investigated is between 3 and 13 nm. The critical current density in a test series is greater the larger the product $N_v \times a^2$. (DE)

23728 (CONF-741040–P2, pp 146-153) FREE-ATOM BEHAVIOR OF AUGER ELECTRONS IN SOLIDS. Yin, L. I. (NASA Goddard Space Flight Center, Greenbelt, MD); Tsang, T.; Adler, I. 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

X-ray emission and Auger electron emission are alternate modes of deexcitation of an atom with an inner-shell hole. If this atom is in a solid, and the electron which fills the inner-shell hole originates from the occupied valence band, the resulting x-ray emission spectrum will reflect the structure of the valence band. This is the basis for the well-established technique of band structure studies by means of soft x-ray spectroscopy. Analogously, if one or both electrons involved in the Auger process originate from the band, it can be expected that band structure information should also be reflected in the Auger spectra. Experimental evidence that this is not the case for the d-band metals such as Cu, Zn, Ag, and Cd is presented. It is shown that the Auger spectra resulting from transitions involving band electrons do not exhibit band structure, but rather show characteristics of free atoms. Explanations for this phenomenon as well as some interesting physical implications are discussed.

23729 (HEDL-TME-75-82) EFFECT OF TEMPERATURE ON THE FATIGUE-CRACK PROPAGATION BEHAVIOR OF A-286 STEEL. James, L. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Contract E(45-1)-2170. Dep. NTIS $4.50.

The techniques of linear-elastic fracture mechanics were used to characterize the effect of temperature upon the fatigue-crack growth behavior of A-286 steel in an air environment over the temperature range of 75–1000°F. In general, the fatigue-crack growth rate increased with increasing temperature. Two material forms were tested: 0.5 inch-thick strip material and 1.5 inch-diameter bar. Two different crack orientations were tested in each product form. In general, no significant differences in crack growth behavior were noted between product forms nor between the different crack orientations. (auth)

23730 (IS-2629) DIFFRACTION EVIDENCE FOR AN FCC IN EQUILIBRIUM HCP TRANSFORMATION IN YTTERBIUM. Kayser, F. X. (Ames Lab., Iowa (USA)). Apr 1971. Contract W-7405-eng-82. 36p. Dep. NTIS $5.00.

X-ray powder patterns obtained from polycrystalline wires of high-purity Yb in several heat treated conditions have demonstrated (i) the existence of a martensitic transformation, beta-Yb (fcc) reversible alpha-Yb(hcp) and (ii) that the hexagonal close-packed structure is the thermodynamically stable form of Yb at temperatures below approximately 270°K. Precision lattice parameters determined for both polymorphs at room temperature indicate the fractional volume change on the transformation to be 0.0091, a magnitude that is consistent with the belief that alpha-Yb is divalent. This can be regarded as a stacking fault transformation, and one wherein the preponderance of the volume change is accommodated by displacements normal to the habit plane. (auth)

23731 (IS-M-60) MAGNETO-RESISTIVITY OF BETA–CERIUM. Burgardt, P.; Legvold, S.; Queen, J. H.; Gschneidner, K. A. Jr. (Ames Lab., Iowa (USA)). 1975. 9p. (CONF-751209-22). Dep. NTIS $3.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Longitudinal magneto-resistivity measurements of allotropically pure samples of dhcp cerium were made at temperatures from 4.2 to 90°K in fields up to 80 kOe. The results show negative magneto-resistivity, which is typical of field suppression of spin flip scattering. In the vicinity of the Néel temperature complex results were obtained which are interpreted as the interaction of internal fields with the applied field. (auth)

23732 (LA-6064-MS) DUCTILE TO BRITTLE TRANSITION OF U–0.75 WT PERCENT Ti PENETRATOR CORES. Jones, T. L.; Sandstrom, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-Eng-36. 10p. Dep. NTIS $4.00.

V-notch Charpy impact specimens were machined from U–0.75 wt percent Ti penetrator cores supplied by the Air Force Armament Laboratory. The response of these specimens to impact loads at various temperatures was measured. The data indicated that the impact energy required to cause fracture was a function of temperature and appeared to be insensitive to microstructural and hardness variations. All tests from –54 to 300°C indicated a brittle condition with data fitting the impact energy equals 4.41e/sup 0.0048 t/ equation. (auth)

23733 (LA-6069-MS) HIGH-DENSITY METALS AND METALLIC COMPOSITES FOR IMPROVED FRAGMENTATION SUBMUNITIONS. Craig, B. G.; Honnell, R. E.; Lederman, G. F. Jr.; Sandstrom, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-Eng-36. 26p. Dep. NTIS $5.00.

The fragmentation of cases (50.8-mm-id) made of tungsten, a tungsten alloy, and depleted uranium (D-38) can be controlled, and velocities greater than 1 mm/mu s can be achieved for lethal size fragment weights. Fragmentation was controlled by internal grooves, by internal screens, and by a spheroid-in-weak-matrix scheme. A thin polymer liner was used inside of a grooved tungsten case in one experiment; this system performed exceptionally well. The ease of fabricating cases with D-38 or with the tungsten-alloy spheroid-in-matrix scheme offers an attractive advantage over tungsten and tungsten alloy.

23734 (LBL-4504) CREEP RUPTURE PROPERTIES OF LAVES PHASE STRENGTHENED Fe–Ta–Cr–W AND Fe–Ta–Cr–W–Mo ALLOYS. Singh, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 57p. Dep. NTIS $4.50.

Thesis.

A small addition of tungsten (0.5 at. percent) was shown to have an effect similar to that of molybdenum on the phase transformation characteristics of alloy Ta7Cr (with a nominal composition of 1 at. percent Ta, 7 at. percent Cr, balance Fe). The existence of time-temperature dependent transformation behavior in alloy Ta7Cr0.5W was confirmed. The effect of spheroidization time and temperature on creep strength was determined. In addition, effect of mechanical processing prior to aging, on creep strength was also determined. It was also shown that by suitable modifications of composition, the grain boundary film can be broken during the aging treatment without the use of spheroidization treatment. Microhardness, tensile and creep properties have been determined. Optical metallography and scanning electron microscopy have been used to follow the microstructural changes and mode of fracture. The creep rupture strength of alloy Ta7CrW alloy was found to be superior to many of the best commercially available ferritic alloys at 1200°F. (21 fig., 8 tables) (auth)

23735 (ORNL-5085) CREEP-RUPTURE PROPERTIES OF A WELD-OVERLAID TYPE 304 STAINLESS STEEL FORGING.

Klueh, R. L.; Canonico, D. A. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 31p. AT.

The creep-rupture properties of a cylindrical type 304 stainless steel forging weld overlaid with type 308 stainless steel weld metal were evaluated. Tests were made at 482, 538, and 593°C on tangential and radial (relative to the axis of the forging cylinder) specimens taken from the weld metal, from the forging as forged, and the forging adjacent to the weld metal-forging interface. Two types of axial specimens were also tested: specimens taken from the unaffected forging, and specimens taken across the fusion line that contained both weld metal and forging. At all temperatures, the rupture strength of the forging immediately adjacent to the fusion line was slightly greater than that of the forging specimens taken at a distance from the fusion line. All forging specimens were stronger than the type 308 stainless steel of the overlay weld metal. The only effect of orientation was found for the overlay weld metal, in which the tangential specimens had a slightly greater rupture life than the radial specimens (the minimum creep rates for the two orientations were similar). At 538 and 593°C the ductilities of the overlay weld metal continuously decreased with increased rupture life. A minimum was found for the ductility-rupture life relationship of the type 304 stainless steel forging specimens at 593°C while at 538°C, the ductility continuously decreased with increased rupture life. 6 tables, 15 figures. (auth)

23736 (ORNL-5107) MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS. Quarterly Progress Report for Period Ending October 31, 1975. Hill, M. R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 364p. AT.

Research on mechanical properties and sodium effects is reported for the following materials: stainless steels (Types 304 and 316), 2¼ Cr–1 Mo steel, Inconel 718, and Incoloy 800. Contributors are: ANL, ORNL, NRL, HEDL, Westinghouse, Univ. of Cincinnati, UCLA, and GE. (DLC)

23737 (PWA-2206(Vol.1)) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Interim Final Report, July 1, 1959–December 31, 1962. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 1962. 275p. Dep. NTIS $9.00.

Several methods of applying high-emittance coatings have been investigated. Of these, the two most successful methods were thermal spraying and aluminum-phosphate bonding. These two methods were used in the application of a variety of coatings to several substrate materials including molybdenum, AISI-310 stainless steel, and niobium-1% zirconium. Both total hemispherical and spectral normal emittance measurements were made at temperatures ranging from 200 to 3100°F, at indicated pressures as low as 4×10^{-9} mm Hg. Emittance changes resulting from exposure to elevated temperatures for periods up to 900 hours were determined for the more promising materials. In addition, the stability and adherence of three coating materials were determined for periods extending over 10,000 hours at a temperature of 700°F and a pressure of 10^{-7} mm Hg. These three materials were tested on SNAP-8 or Sunflower I tube-half fin radiator sections. Of particular interest as coatings are calcium titanate, iron titanate and iron titanate with aluminum oxide, silicon carbide, nickel chrome spinel, crystalline boron, acetylene black, and stannic oxide. (auth)

23738 (UCRL-Trans-10993) STUDY OF THE MELTING OF SIMPLE SUBSTANCES UNDER HIGH PRESSURES. Stishov, S. M. (AN SSSR, Moscow. Inst. Kristallografii). Dec 1975. Translation of Russian Dissertation Summary. 52p. Dep. NTIS $4.50.

Results of studies on the thermodynamic properties of Ar, Na, and Cs are reported. The main laws governing the thermodynamics of melting of these elements were established. Experimental P-V-T data were obtained characterizing the equations of state for the liquid and solid phases of argon, sodium, and cesium at pressures up to 17×10^3 kg/cm² (Ar), 22×10^3 kg/cm² (Na, Cs), and temperatures up to 75°C (Ar), 220°C (Na), and 200°C (Cs). Thermodynamic functions and their derivatives were calculated for the liquid and solid phases of these elements using empirical equations of state approximating the experimental P-V-T data with good accuracy. (auth)

23739 PLASTIC FLOW OF ORDERED Zr_3Al. Schulson, E. M. (Atomic Energy of Canada Ltd., Chalk River, Ontario, Chalk River Nuclear Labs.). J. Nucl. Mater.; 57: No. 1, 98-102 (Jul 1975).

Room-temperature tensile experiments established that ordered Zr_3Al of the Ll_2 type obeys the relationship $\sigma_\epsilon = \sigma_{0,\epsilon} + kd^{-\frac{1}{2}}$ where σ_ϵ is the flow stress at a given strain ϵ, $\sigma_{0,\epsilon}$ is a strain-dependent frictional stress, d is the average grain diameter, and k is a strain-independent constant of magnitude (2.8 ± 0.3) kg/mm$^{\frac{3}{2}}$. Zr_3Al flows by fine, planar slip, and is susceptible to intergranular cracking. (NL)

23740 MASS TRANSPORT OF CHROMIUM AND NICKEL IN MONEL-400. Paul, A. R.; Naik, M. C.; Kaimal, K. N. G. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). J. Nucl. Mater.; 58: No. 2, 205-210(Nov 1975).

Diffusion of ^{51}Cr and ^{63}Ni in Monel-400 has been studied in the temperature ranges 1023–1573°K for volume diffusion and 713-1123°K for grain boundary diffusion, respectively. Grain boundary diffusivities evaluated by Whipple and Suzuoka's method were found to be in good agreement but Fisher's analysis yielded values of diffusion coefficients that were 2 to 4 times lower. Segregation of ^{51}Cr and ^{63}Ni has been studied by autoradiography. It was observed that at lower temperatures (≤900 K) material transport in specimens with approximately 300 μm grain diameter is mainly through the grain boundaries. (NL)

23741 TECHNIQUES OF MEASURING THE DIFFUSION COEFFICIENTS IN PLUTONIUM. Application to the Diffusion of Cobalt in Plutonium Epsilon(cc). Charissoux, C.; Calais, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). J. Nucl. Mater.; 57: No. 1, 45-55(Jul 1975). (In French).

The diffusion of ^{60}Co in bcc epsilon plutonium has been studied by the sectioning method, and the following results have been obtained: $D = 1.4 \times 10^{-3} \exp(-9900/RT)$ cm²/sec over the temperature range 484–621°C. Cobalt diffuses rapidly in epsilon Pu. Since the diffusion coefficient does not change across the phase transition epsilon Pu (fcc) → epsilon (bcc), the diffusion mechanism must be dissociative in the two phases. (NL)

23742 STUDIES ON THE PERMEATION OF HYDROGEN AND TRITIUM IN NUCLEAR PROCESS HEAT INSTALLATIONS. Roehrig, H. D.; Hecker, R.; Blumensaat, J.; Schaefer, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Nucl. Eng. Des.; 34: No. 1, 157-167(Oct 1975).

To realistically evaluate the important problems of hydrogen and tritium permeation in nuclear heated high temperature systems, estimates are made, among others, on the basis of the authors' preliminary experimental data. Steam-methane reforming is used as the key process. The results show that oxide layers can decrease the hydrogen permeation rate by more than two orders of magnitude and that not only the oxidation potential and temperature but also the water partial pressure may be essential for the formation and possibly the structure of oxide layers, and consequently for the permeation rate. The consequences of the experimental data for the permeation of tritium are also discussed. The available empirical data and results of the measurement discussed here still contain large uncertainties. It will therefore be necessary to carry out, under as realistic conditions as possible, a broad parameter study of heat exchanger materials which are seriously considered for use in nuclear process heat installations. (NL)

23743 TEMPERATURE DEPENDENCE OF A ZIRCALOY-4 STRENGTH DIFFERENTIAL. Lucas, G. E.; Bement, A. L. J. Nucl. Mater.; 58: No. 2, 163-170(Nov 1975).

An investigation was undertaken to determine the behavior of the strength-differential in the three principal directions of α-rolled, Zircaloy-4 plate as a function of temperature. The method of using Knoop hardness numbers to generate yield loci was employed in determining the magnitude of the strength differential. It was found that the magnitude of the strength-differential was proportional to the concentration of basal poles along the direction of consideration and that it decreased in magnitude with increasing temperature. However, it remained of significant magnitude (approximately 85 MPa) in both the transverse and normal directions at light water reactor operating temperatures. Use of the elevated temperature, strength-differential data in clad creep down analyses demonstrated that the consideration of the strength-differential in clad creep analysis can increase predicted collapse times by a factor greater than two in pressurized water reactor fuel pins. It was also found that the strength-differential effect on such predictions is sensitive to clad texture. (NL)

23744 EXHAUSTION MECHANISMS IN THE PREYIELD DOMAIN OF NIOBIUM SINGLE CRYSTALS AT LOW TEMPERATURES. Boudet, A.; Kubin, L. P. (Centre National de la Recherche Scientifique, 31–Toulouse (France). Lab. d'Optique Electronique). J. Phys. (Paris); 36: No. 9, 823-833(Sep 1975).

Pure niobium single crystals were tested by tension and by stress-relaxation at stresses below the macroscopic yield stress and at temperatures between 4.2 and 70°K. The slope of the stress-strain curve and the amount of stress relaxation were investigated as a function of the nature and density of dislocations initially

present in the sample. In the preyield domain the dislocation mobility was found to be governed by a thermally activated phenomenon associated to an exhaustion mechanism. This behavior was quantitatively discussed in a model, in which edge dislocations undergo fragmentation, when the stress increases, as a result of their interaction with interstitial impurities. (FR)

23745 CERAMICS–LIQUID METALS. Compatibilities and Angles of Wetting. Geirnaert, G. Bull. Soc. Fr. Ceram.; No. 106, 7-23(Jan 1975). (In French)

This is a bibliography on the problems at the contact of ceramics with liquid metals. The phenomena governing the attack on ceramics by liquid metals from a thermodynamic viewpoint, and the static and dynamic kinetics of corrosion are described. References to articles and principal works giving the thermodynamic values of ceramics are given in an appendix. The theories governing wetting phenomena (angle of wetting, surface energies, adhesion work) are summarized. The various factors affecting wetting (surface roughness, time, impurity, atmosphere) are described. The result of the principal work done on compatibility or reaction between ceramics and liquid metals are grouped in tables by liquid metal or alloy. The ceramic-liquid metal wetting angles given in the literature are given in the same form. (FR)

23746 EFFECT OF THE FORM OF PHASE TRANSFORMATION FRONT ON THE TEXTURE OF β-QUENCHED URANIUM. Zelenskii, V. F.; Stukalov, A. I.; Azarenko, A. V.; Gaidamachenko, G. S.; Kunchenko, V. V.; Royenko, N. M. At. Energ. (USSR); 39: No. 3, 191-194(Sep 1975). (In Russian).

The effect of the form of phase transformation front on uranium quenching texture has been studied. Various cooling conditions have been used to achieve appropriate phase front configurations. The texture formed in uranium during longitudinal quenching has an apparent non-uniform distribution over the rod cross section. [010] texture predominates in surface layers, while [100] prevails in the central zone. By varying the phase front configuration (e.g., by varying the speed of rod movement in the coolant), the uranium quenching texture level and type can be changed along with the degree of non-uniformity of quenching texture distribution over the rod cross section. The regularities can be explained by the orientational effect of structure and thermal stresses existing at the phase boundary on nucleation and crystal growth in α-uranium during phase transition. The effect of β-quenched uranium core texture on fuel element radiation deformation is examined.

23747 EFFECTS OF COLD WORKING AND PRE-IRRADIATION HEAT TREATMENT OF VOID FORMATION IN NEUTRON-IRRADIATED TYPE 316 STAINLESS STEEL. Brager, H. R. (Westinghouse Hanford Co., Richland, Wash. (USA)). J. Nucl. Mater.; 57: No. 1, 103-118(Jul 1975).

The effect of fast-neutron irradiation on void formation in Type 316 stainless steel having undergone specific thermal-mechanical treatments was investigated by transmission electron microscopy. The study showed that, for irradiation at the three lower temperatures (420, 475, and 580^{0}C): (1) the void volume decreased with increasing cold work; (2) the reduction in swelling was due to a decrease in both void-number density and void size; (3) the decrease in void size with increasing cold-work level was enhanced at higher irradiation temperatures; (4) cold working from 0 to 10 percent decreased the void-number density, and void volume, more than in the range from 10 to 20 percent; (5) void formation in the 20 percent cw steel which had been heat treated 100 h at 650^{0}C before irradiation was similar to that of the solution-treated steel. The temperature dependence of swelling of the cold-worked material was different from that of the solution-treated steel. (NL)

23748 INVESTIGATION OF THE ELECTRONIC CHARACTERISTICS OF SUPERCONDUCTIVE NIOBIUM–TIN ALLOY FILMS. Vedeneev, S. I.; Golovashkin, A. I.; Levchenko, I. S.; Leskova, T. A.; Motulevich, G. P. pp 315-319 of Elektronnaya Struktura Perekhodnykh Metallov, Ikh Splavov i Soedineniy. Kiev; Naukova Dumka (1974). (In Russian).

Films of niobium–tin alloys, and in particular Nb_3Sn compounds, were prepared by simultaneous sputtering of the initial metals from different atomizers in a vacuum of 5×10^{-6} mm Hg onto substrates heated to 700 to 900°C with subsequent annealing. The thickness of the films was 0.03 to 2.0 μm. X-ray studies of Nb_3Sn films showed that they have A15 structure. For these films it is found that the superconductive transition point T_c = 17.8 to 18.3°K and the resistance ratio $R_{293\ K}/R_{res}$ = 1.5 to 3.5. An exponential term contributes to the resistance R(T) appreciably at all temperatures. Detailed measurements of the optical constants for films of Nb_3Sn in a broad spectral interval (in the visible and infrared regions) gave the characteristics of both conduction electrons and electrons which participate in interband transitions. A correlation is established between the T_c and the conduction electron concentration for films of Nb–Sn alloys. The maximum T occurs at a concentration of 1.1×10^{22} electrons per cc. In accordance with data of optical measurements a quantitative relation is found between the constant of electron-phonon interaction and composition of the alloy, with maximum corresponding to the compound Nb_3Sn. A correlation is found between the concentration dependences of the mean free path of electrons and the width of the superconductive transition. Data of tunnel measurements show the existence of four energy gaps in Nb_3Sn, with ratio $2\Delta/kT_c$ = 0.2 to 3.0. (Ref. Zh.)

23749 ELECTRON CHARACTERISTICS OF SOME SUPERCONDUCTIVE TRANSITION METALS AND THEIR ALLOYS OBTAINED BY AN OPTICAL METHOD. Motulevich, G. P.; Golovashkin, A. I.; Shubin, A. A. pp 311-314 of Elektronnaya Struktura Perekhodnykh Metallov, Ikh Splavov i Soedineniy. Kiev; Naukova Dumka (1974). (In Russian).

The electron characteristics of the superconductive transition metals Nb, V, Ti; and alloys $Nb_{0.8}Ti_{0.5}$, $V_{0.74}Ga_{0.26}$, and Nb_3Sn obtained by an optical method are described. The method consists in measuring the optical properties (real and imaginary components of permittivity) over a broad spectral region and distinguishing the contributions from conduction electrons and from electrons which participate in Bragg interband transitions. Formulas are given for determining electron characteristics, and such characteristics are found for the investigated materials: concentration of conduction electrons and the ratio of this concentration to that of the valence electrons, effective frequency of electron collisions, frequency of collisions between electrons and phonons, average velocity of electrons on the Fermi surface, moduli of the Fourier components of pseudopotentials for various Bragg planes, frequencies of collisions of electrons which participate in interband transitions, and the constant of electron-phonon interaction. The experimental results agree satisfactorily with a model based on hybridization of s- and d-electrons. It is shown that there is a correlation between the temperature of transition to the superconductive state and the concentration of conduction electrons. (Ref. Zh.)

23750 EFFECT OF SOLUTE CONVECTION UPON MACROSEGREGATION OF OFF-EUTECTIC COMPOSITE GROWTH. Verhoeven, J. D. (Ames Lab., IA); Kingery, K. K.; Hofer, R. Metall. Trans.; 6B: 647-652(Dec 1975).

Vertical solidification experiments have been carried out on Pb–Sn and Pb–Cd alloys at hypereutectic compositions where solute convection was present. A significant amount of macrosegregation was observed due to the convection, and the macrosegregation was found to be independent of tube diameter for those diameters studied, 3 to 6 mm. The resulting macrosegregation correlated well with existing theories. The experiments employed a temperature gradient of 360^{0}C/cm and it was found that thermotransport made a significant contribution to the observed macrosegregation at growth rates below around 5 mu m/s. (auth)

23751 ENTROPIES OF TRANSFORMATION AND FUSION OF THE METALLIC ELEMENTS. Gschneider, K. A. Jr. (Ames Lab., IA). J. Less-Common Met.; 43: 179-189(1975).

The entropy of transformation of metals which possess two or more of the common metallic structures and the entropy of fusion of metals which have one of these structures prior to melting were analyzed. It is concluded that both entropies are dependent upon the crystalline structure of the phases involved and the number of valence electrons, except for transitions between the close-packed structures, hcp yields fcc and dhcp yields fcc, for which the entropy of transformation is apparently only structure dependent. Application of these correlations enabled the prediction of the entropies of fusion for 16 metals and the entropies of transformation for 5 metals for which no reliable experimental data exist. (auth)

23752 EFFECT OF ALLOYING A VANADIUM SUBSTRATE ON THE STRUCTURE AND SUPERCONDUCTING PROPERTIES OF THE COMPOUND V_3Ga. Vorob'eva, N. S.; Sokolov, V. I.; Pakhomov, V. Ya.; Bondarenko, E. A.; Shneider, M. D. pp 72-77 of Struktura i Svoistva Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Studies were made of the effects of alloying a V substrate with Ti, Zr, Hf, Nb, or Ta, at levels below the solubility limits, on the structure and superconducting properties of V_3Ga produced by the diffusion method on the substrate. Alloying with Ta and particularly Zr produces grain refinement of the V_3Ga. Alloying with Ti, Nb, and Ta increases the critical c.d. in fields of 50 kOe. (Metals Abstr.)

23753 USE OF PLANNED EXPERIMENTS TO STUDY SUPERCONDUCTING MULTICOMPONENT SYSTEMS. Savitskii, E. M.; Efimov, Yu. V.; Baron, V. V.; Vychkova, M. I.; Kozlova, N. D. pp 44-50 of Splavy Redk. Met. s Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The simplex lattice method using a computer was used to construct composition property diagrams of β solid solutions with bcc lattices of the V–Nb–Ta–Ti system, A15 type solid solutions, and the pseudo-quaternary V_3Si–V_3Ga–V_3Sn–V_3Ge systems. The properties determined included T_c, H_μ, ρ12°K, ρ300°K, and the lattice constants. The calculated data agreed with experimentally determined values within the limits of experimental error. The T_c of the quaternary alloys were no higher, but those of the pseudo-quaternaries were lower than the T_c values of the corresponding binary compounds. The correlations between the properties studied are discussed. (Metals Abstr.)

23754 EFFECT OF SAMARIUM ON THE SUPERCONDUCTING PROPERTIES OF Nb_3Sn AND Nb_3Al. Savitskii, E. M.; Baron, V. V.; Bychkova, M. I.; Sumarokov, V. N. pp 57-62 of Struktura i Svoistva Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The effects of Sm additions of 1 to 5% on the superconducting transition temperature, T_c, and structure of Nb_3Sn and Nb_3Al in the case and heat-treated conditions were determined. Sm has negligible solubility in Nb_3Al and Nb_3Sn. There is no reduction in T_c on adding Sm to either compound. (Metals Abstr.)

23755 EFFECT OF THE RATE OF QUENCHING AND NITROGEN CONTENT ON THE STRUCTURE AND SUPERCONDUCTING PROPERTIES OF VANADIUM AND NIOBIUM AND SOME OF THEIR ALLOYS. Savitskii, E. M.; Revyakin, A. A.; Efimov, Yu. V.; Glyuzitskii, B. D.; Sumarokov, V. N. pp 145-156 of Struktura i Svoistva Sverkhprodyashch. Materialov. Moscow; Izdatel' stvo Nauka (1974). (In Russian)

The effects of quenching rates and N contents ≤1.5% on the superconducting properties of V, Nb, and some of their alloys with Ti were determined. Rapid quenching from the liquid state can retain a single-phase solid solution with significant contents of N. This process causes grain refinement of the solid solution and of the nitride and ω-phase particles. Increases occur in the critical c.d., the dislocation density, the strength, and the hardness, while the ductile properties simultaneously increase. The effect is also to neutralize the deleterious effect of N on the superconducting critical temperature of the materials studied. (Metals Abstr.)

23756 EFFECT OF DEFORMATION ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF NIOBIUM AND VANADIUM SINGLE CRYSTALS. Savitskii, E. M.; Baron, V. V.; Myzenkova, L. F.; Sumarokev, V. N. pp 100-105 of Struktura i Svoistva Sverkhprodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Results are given from measurements of the effect of deformation on the superconducting transition temperature, T_c, and the width of the ΔT_c transition for Nb and V single crystals obtained by electron-beam zone melting. Deformations of ≤80% lower T_c and increase ΔT_c. (Metals Abstr.)

23757 STRUCTURE AND SUPERCONDUCTING PROPERTIES OF TERNARY ALLOYS BASED ON COMPOUNDS. Savitskii, E. M. pp 77-84 of Struktura i Svoistva Sverkhprodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The structures and superconducting properties of ternary alloys based on Nb_3Sn, Nb_3Ge, V_3Si, and V_3Ga were determined and the laws governing the superconducting transition temperature, T_c, established. T_c varies continuously with composition in the region of ternary solid solutions with a singular maximum at the formation of a superconducting ternary compound and a constant T_c for the superconducting phases in the three-phase region. In the two-phase regions of alloys of the ternary systems, T_c of the superconducting phase varies as a result of changes in the chemical composition. (Metals Abstr.)

23758 X-RAY ANALYSIS OF HIGH COERCIVITY $SmCo_5$ POWDERS. Ul'yanov, A. I. Tr. Tyumenskogo Ind. Inst.; No. 23, 181-187(1973). (In Russian)

The effect of lattice distortion as produced by various degrees of grinding (5 to 50 μm) on the coercivity, H_c, of $SmCo_5$ powders was studied using x-ray analysis of the (101) and (202) lines to assess: (i) the mean block sizes, (ii) the rms misfit angle, and (iii) the microstresses. Grinding decreases (i) but increases (ii), the latter leading to an increase in both dislocation density and H_c. With greater increase in the degree of grinding there is a sharp increase in microdeformation which is probably one of the causes of the fall in H_c that occurs under these conditions. (Metals Abstr.)

23759 CALCULATION OF THE ELECTRICAL PROPERTIES OF ALLOYS. Savitskii, E. M.; Burov, I. V.; Pirogova, S. V. pp 152-156 of Splavy Redk. Met. s Osobymi Fiz. Svoistvami. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Studies were made of the effect of alloying temperature, dislocations, and vacancies on the electrical properties of alloys. A method was developed for the numerical assessment of the electrical conductivity of solid solutions based on metals with a cubic lattice. As an example, a quantitative assessment is made of the contribution of dislocations and vacancies to the electrical resistance of a Mo single crystal at 4.2°K. (Metals Abstr.)

23760 X-RAY SPECTRUM INVESTIGATION OF THE COPPER OUTER ENERGETIC BAND STRUCTURE IN THE ALLOYS OF THE ZIRCONIUM–COPPER SYSTEM. Nemoshkalenko, V. V.; Nagorny, V. Ya.; Mamko, B. P.; Yatsenko, B. A. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1602-1605(Oct 1975). (In Russian)

Results of investigation of copper x-ray K- and L-emission spectra in $ZrCu_4$, $ZrCu_3$, Zr_2Cu_3, ZrCu, and Zr_3Cu are reported. An intensive increase of the high-energy maximum in K-bands and appearing of the high-energy hump in L-bands of copper were noticed in these compounds. New structure details of the bands are interpreted as a result of presence of zirconium electronic states in the copper emission spectra. (auth)

23761 SURFACE LATTICE DYNAMIC PROPERTIES OF THE TUNGSTEN (100) FACE. Boiko, B. A. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1705-1714(Oct 1975). (In Russian)

The effective Debye temperature (θ) dependence on the electron energy for the (00) and (10) beams was determined by the low energy electron diffraction technique on the W (100) face through the temperature changes of reflection intensity. The new method of accounting the background under the reflection is suggested allowing the estimation of the background and reflection diameter. This provides for a relatively accurate measurement of the true intensity of corresponding beams. The intensity profiles are measured for (00) and (10) beams of the W (110) face. The Debye temperatures corresponding to the Wulf-Bragg peaks increase monotonously with the energy, achieving the volume values at 450 eV; θ corresponding to additional peaks are nearly independent of the energy and seem to be determined by the multiple scattering into the deep atom layers. The mean-square displacement ratio of atoms in the volume and on the surface of a single crystal is equal to 2.54; the Debye frequency of atom vibrations on the surface is 1.6 times as small as in the volume. (auth)

23762 INDIUM FILMS ON THE TUNGSTEN (100) FACE. Boiko, B. A. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1717-1722(Oct 1975). (In Russian)

The structure and the work function of In films on W (100) was studied by the low-energy electron diffraction (LEED) and the contact potential difference techniques. In forms of W (100) two surface structures: W (100)–p (1 × 1) In and W (100)–c (2 × 2) In; the latter seems to involve the activation energy for its formation. The Debye temperatures θ for these structures was determined by the temperature dependence of the LEED reflection intensity; the relation of the In adatom binding energies with the W (100) surface was estimated by θ in these structures: it proved to be ≈ 0.6. The binding energy of In atoms in the volume indium is two times as low as the respective value in the p (1 × 1). (auth)

23763 STUDY OF LITHIUM DIFFUSION BY DISLOCATIONS IN Mo, W, AND THEIR ALLOYS. Ivashchenko, Yu. N.; Isaichev, V. I.; Larikov, L. N.; Cherepin, V. T. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1723-1728(Oct 1975). (In Russian)

The diffusion coefficients of lithium in the monocrystalline Mo, W, and their alloys were determined for the various crystallographic orientations and density dislocation distribution. At the temperature of 1770°K lithium penetrates into monocrystalline Mo, W, and their alloys mainly by dislocations. Nevertheless the volume diffusion of lithium was observed in Mo and its alloys. (auth)

23764 MAGNETIC PROPERTIES OF RMn_2Ge_2 COMPOUNDS (R equals La, Ce, Pr, Nd, Gd, Tb, Dy, Ho, Er, AND Th). Narasimhan, K. S. V. L.; Rao, V. U. S.; Bergner, R. L.; Wallace, W. E. (Univ. of Pittsburgh). J. Appl. Phys.; 46: No. 11, 4957-4960(Nov 1975).

The magnetic properties were investigated from 4.2 to 500°K. $LaMn_2Ge_2$, $CeMn_2Ge_2$, $PrMn_2Ge_2$, and $NdMn_2Ge_2$ are ferromagnetic with Curie temperatures of 306, 316, 334, and 334°K, respectively. The heavy rare-earth compounds do not order ferromagnetically until low temperatures. $GdMn_2Ge_2$ shows a sharp magnetic transition at 97°K both in the magnetization-vs-temperature and resistivity-vs-temperature data. For this compound, it is proposed that above 97°K the Mn moments order antiferromagnetically among

themselves while the Gd moments are disordered. Below 97°K, the Mn moments couple ferromagnetically with each other but are opposed to the ordered Gd sublattice. Magnetic moment obtained at 4.2°K can be explained for all the compounds on the basis of an antiferromagnetic coupling between Mn and rare-earth spins. (auth)

23765 SELF-HEATING EFFECTS IN THIN-FILM TYPE-1 SUPERCONDUCTORS. Huebener, R. P. (Argonne National Lab., IL). J. Appl. Phys.; 46: No. 11, 4982-4985(Nov 1975).

Current-induced electrical resistance was investigated for zero applied magnetic field in long superconducting strips of tin 100 to 200 mu m wide and up to a few mu m thick. Self-heating effects were observed similar to those reported recently by Skocpol, Beasley, and Tinkham (SBT) for "one-dimensional" tin microbridges with dimensions much smaller than those of our samples. Results agree well with the one-dimensional SBT hotspot model for long microbridges. In the presence of an inductive load, relaxation oscillations can be observed resulting from the negative differential resistance region in the V-I characteristic. (auth)

23766 USE OF THE EMANATION METHOD TO STUDY SINTERING OF THORIUM METAL. Os'kina, T. E.; Zaborenko, K. B.; Tsibanov, V. V. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 640-643(1974).

Translated from Radiokhimiya; 16: No. 5, 650-653(1974).

A study was made of the sintering of thorium by hydrostatic determination of the density and the emanation method. The self-diffusion coefficients of thorium were obtained from data on sintering. The activation energy of self-diffusion of thorium equals 75 ± 6 kcal/g-atom. The stages of sintering were separated out by means of the emanation method. The initial section of "unestablished" sintering, which is characterized by diffusion of distorted surface layers of the substance, was distinguished. (auth)

23767 EFFECT OF TEMPERATURE AND RHENIUM ADDITION ON THE AMPLITUDE-DEPENDENT TUNGSTEN INTERNAL FRICTION. Benieva, T. Ya.; Golub, T. V. (AN Ukrainskoj SSR, Kiev. Inst. Metallofiziki). Metallofizika; No. 50, 59-61(1974). (In Russian)

In monocrystals of W and of W + 0.1 wt % Re the amplitude-temperature dependence of internal friction, the value of the critical micro stress of rupture, and its temperature dependence were studied. The temperature dependence of the length of the dislocation segments was determined. The observed anomaly of the parameters that characterize the mobility of the dislocations in the W-Re may be related to the change in the temperature dependence of the degree of strengthening of the dislocations by atoms of the impurity. (tr-auth)

23768 INFLUENCE OF THE RECRYSTALLIZATION PROCESSES KINETICS ON THE VM-1 ALLOY DURABILITY UNDER THE THERMAL CYCLING CONDITIONS. Brik, V. B.; Uskov, E. I.; Fal'chenko, V. M. (AN Ukrainskoj SSR, Kiev. Inst. Problem Prochnosti). Probl. Prochnosti; No. 11, 53-57(Nov 1974). (In Russian)

For English translation see the journal Strength Mater.

The results of studies on the growth rate of recrystallization centers and grains in the alloy VM-1 are presented. The temperature coefficient of the grain growth rate was close to the value of the activation energy of boundary self diffusion in molybdenum. With creep (under thermocycling conditions) the grain growth rate increased as a result of a decrease in the barrier energy with movement of the atoms to the grain boundary. (tr-auth)

23769 MECHANISM OF JUMP-LIKE MAGNETIC REVERSAL OF $SmCo_5$ AND $GdCo_5$ SINGLE CRYSTALS. Ermolenko, A. S.; Korolev, A. V.; Lagunova, V. I.; Shcherbakova, E. V. (AN SSSR, Sverdlovsk. Inst. Fiziki Metallov). Fiz. Met. Metalloved.; 38: No. 5, 1001-1011(Nov 1974). (In Russian)

For English translation see the journal Phys. Met. Metallogr.

The dependence of the field H_k, in which jump-like magnetic reversal of spherical monocrystals of the compounds $SmCo_5$ and $GdCo_5$ occurred, was studied as a function of the dimensions of the sample, temperature, and intensity of the magnetizing field. The effect of defects, artificially produced on the sample surface, on the magnitude of H_k was also studied. Values of H_k are determined by the field at the start of nucleation, available in the sample at the moment of its magnetic reversal. (tr-auth)

23770 MICROPLASTICITY IN b.c.c. METALS. Feltham, P.; Hawkins, A. (Brunel Univ., Uxbridge (UK)). Mater. Sci. Eng.; 17: No. 2, 239-246(Feb 1975).

Stress relaxation was studied in polycrystalline Nb, Mo, and W of 99.95% purity at 77 to 298°K. The relaxation following prestraining to stresses not exceeding 70-80% of the macro-yield level was logarithmic, with the slope $s = d\sigma/d \ln (t + t_0)$ proportional to the tensile stress σ. At higher stresses the relation between s and σ was again linear, but $ds/d\sigma$ assumed a new, constant value. These observations, certain anomalies in the relaxation behavior apparent particularly with high stresses and prestraining rates, and the observed temperature dependence of s, are consistent with an interpretation in which mainly edge dislocations, impeded in their movement by structural defects and by impurities, control and relaxation in the low-stress region; at higher stresses dynamic recovery involving migration of jogged screw dislocations appears to be rate determining. (auth)

23771 FATIGUE STRENGTH INVESTIGATION OF THE MLT-1 MOLYBDENUM ALLOY AND ITS WELDED JOINTS. Gal'perin, M. Ya.; Glazunov, M. G.; Danyushchenkov, I. A.; Solodkov, A. I.; Yakushina, A. I. Probl. Prochnosti; No. 11, 85-90(Nov 1974). (In Russian)

For English translation see the journal Strength Mater.

The resistance of Mo alloy MDT-1 to fatigue under different structural conditions was studied, with subsequent metallographic study of zones subjected to fatigue damage or destruction. A clear difference in fatigue properties of the alloys under different structural conditions was shown. With cyclic addition of load, alloy MDT-1 showed greater durability in the cold-worked and annealed states than in recrystallized. (tr-auth)

23772 VANADIUM TRANSFER PROCESS FROM VANADIUM CARBIDE TO AUSTENITE. Gervas'ev, M. A.; Gol'dshtejn, M. I.; Panfilova, L. M.; Rudenko, V. K. (Ural'skij Politekhnicheskij Inst., Sverdlovsk (USSR)). Fiz. Met. Metalloved.; 38: No. 5, 1038-1043(Nov 1974). (In Russian)

For English translation see the journal Phys. Met. Metallogr.

The process of transfer of vanadium from vanadium carbide to austenite steels 40, 40X2, and 40C2 was studied. Carbide steel couples, obtained by diffusion welding, were annealed in a vacuum furnace at different temperatures and holding times. The diffusion coefficients for vanadium in austenite and at the carbide boundary were determined. The effect of the austenite composition on the process of vanadium transfer from the carbide to the solid solution is explained. (tr-auth)

23773 FRACTURE MODE TRANSITION IN POLYCRYSTALLINE MOLYBDENUM. Johnson, A. A.; Gupta, S. P.; Kodali, S. P. (Washington State Univ., Pullman (USA)). Mater. Sci. Eng.; 18: No. 1, 159-161(Mar 1975).

Several tens of degrees above the temperature of the ductile-brittle transition in molybdenum is another transition in which the mode of fracture changes, with decreasing temperature, from ductile tearing to ductile cleavage. This is usually referred to as the "fracture mode transition". A set of results on polycrystalline molybdenum is presented obtained by simply testing tensile specimens at closely spaced temperature intervals through the fracture mode transition and then carefully examining the fracture surfaces using scanning electron microscopy. The electron microscopy showed clearly that the fracture mode transition was close to room temperature. (auth)

23774 SUBSTRUCTURE INVESTIGATION OF DEFORMED AND ANNEALED MOLYBDENUM MONOCRYSTALS. Levikov, E. A.; Levikova, L. V.; Fedorova, L. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Metallofizika; No. 50, 70-77(1974). (In Russian)

The substructure of Mo monocrystals in the (001) plane and the [110] direction was studied by electron microscopy and x-ray analysis (roentgenographs in congruent and divergent x-ray beams, diffractometry) and by microhardness changes. For all degrees of compression (13 to 64%) and annealing temperatures (600 to 1000°C) studied there was chaotic distribution of the dislocations. The dislocation density was studied from electro-electron-microscope data and by analysis of widening of Bragg lines and of lines obtained in similar x-ray beams. The latter method was used first. The chief increase in dislocation density took place with 20% deformation and further increase with increase in the degree of compression was insignificant. The continuous nature of the deformation in molybdenum up to E ≈ 50% was demonstrated. Annealing of samples up to 1000°C did not change the nature of the dislocation distribution although their density decreased. (tr-auth)

23775 QUALITATIVE X-RAY EVIDENCE OF SHORT-RANGE-ORDER IN SILVER-RICH Ag-Cd ALLOY. Nagender Naidu, S. V. (Defence Metallurgical Research Lab., Hyderabad (India)). Mater. Sci. Eng.; 17: No. 2, 289-291(Feb 1975).

The measurements were made at room temperature for lattice parameter determination of silver-rich Ag-24.3 at. % Cd alloy quenched from different temperatures. Two sets of measurements were carried out on specimens that had received the same initial heat treatment and cooling. In one set the effect of vacancy induced ordering, occurring during quenching, on the lattice param-

eter was examined. In the other set, the lattice parameter of the specimen furnace cooled from the quenching temperature was measured, which exhibits the order characteristic of the annealed state. The two sets of data served as the basis for study of the effect of degree of order on lattice parameter. (auth)

23776 RARE-EARTH METALS INFLUENCE ON CHROMIUM STRUCTURE AND PROPERTIES. Rakitskij, A. N.; Trefilov, V. I. Metallofizika; No. 51, 97-105(1974). (In Russian).

The results of studies on the structure and properties of alloys of chromium with Sc, Y, La, Ce, Pr, Nd, Sm, Gd, Tb, Ho, Dy, Er, and Lu in the cast, deformed, and recrystallized states are presented. The most promising for increasing the low-temperature plasticity of chromium alloys were lanthanum and praesodymium. The optimum rare earth concentration in the chromium was from 0.4 to 0.7 wt. %. From Cr-La and Cr-Pr alloys by means of thermomechanical processing were obtained rods, wires, sheets, foils, and other semifabricates with a transition temperature in the friable state from −80 to −170°C. (tr-auth)

23777 THERMODYNAMIC PROPERTIES OF POROUS TUNGSTEN AT TEMPERATURES 1200°−3200°K. Pustogarov, A. V.; Mel'nikov, G. N.; Kolesnichenko, A. N.; Daragan, V. D.; Chepiga, D. D. Porosh. Metall., Akad. Nauk Ukr. SSR; No. 11, 52-57 (Nov 1974). (In Russian).

For English translation see the journal Sov. Powder Metall. Met. Ceram.

Results of studies on the electrical resistance, thermal conductivity, heat capacity, monochromaticity, and total radiative properties of powdered tungsten (20-35% porosity) at 1200 to 3200°C are presented. (tr-auth)

23778 4*f*-VIRTUAL-BOUND-STATE FORMATION IN $CeAl_3$ AT LOW TEMPERATURES. Andres, K.; Graebner, J.E. (Bell Laboratories, Murray Hill, New Jersey 07974); Ott, H.R. Phys. Rev. Lett. 35: No. 26, 1779-1782 (29 Dec 1975).

Specific-heat and electrical-resistivity measurements in $CeAl_3$ below 0.2 K reveal enormous magnitudes of the linear specific-heat term $C=\gamma T$ ($\gamma=1620$ mJ mole/K^2) and the T^2 term in $\rho=AT^2$ ($A=35$ μΩ cm/K^2). We conclude that the 4*f* electrons obey Fermi statistics at low temperatures because of the formation of virtual bound 4*f* states. (auth)

23779 FIRST-ORDER TRANSITIONS, SYMMETRY, AND THE ϵ EXPANSION. Bak, P.; Krinsky, S.; Mukamel, D. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 36: No. 1, 52-55 (5 Jan 1976).

The first-order nature of the antiferromagnetic transitions in Cr, Eu, UO_2, and MnO can be explained by noting that the corresponding Landau-Ginzburg-Wilson Hamiltonians possess *no* stable fixed points in 4-ϵ dimensions. We predict that all fcc type-I ($\vec{m}\perp\vec{k}$), type-II, and type-III ($\vec{m}\perp[100],\vec{k}=[\frac{1}{2}0\frac{1}{2}]$) antiferromagnetic transitions are first order. (auth)

23780 ELECTRONIC MOMENTS INDUCED BY NUCLEAR MOMENTS IN VAN VLECK COMPOUNDS. Genicon, J.L.; Tournier, R. (Centre de Recherches sur les Très Basses Températures, Centre National de la Recherche Scientifique, 38042 Grenoble Cedex, France). Phys. Rev. Lett. 36: No. 2, 107-110 (12 Jan 1976).

In the Van Vleck compound $(Pr_xLa_{1-x})Sn_3$, we have attained the saturation of nuclear magnetization. The observed saturation value decreases with increasing applied magnetic field. A simple model of "nuclear field" accounts well for this effect. The nuclear moment is enhanced by an electronic contribution equal to the field derivative of the electronic magnetization times the nuclear field. (auth)

23781 SUPERCONDUCTING COPPER-BASE ALLOY CONTAINING FILAMENTS OF V_3Ga. Chen, W.Y.K.; Tsuei, C.C. (California Institute of Technology, Pasadena, California 91109). J. Appl. Phys. 47: No. 2, 715-720 (Feb 1976).

Superconducting copper-rich composites containing V_3Ga filaments have been prepared by a process which consists of melting the constituent elements into ingots followed by subsequent cold working and heat treatment. The composites were fabricated into 1×1-mm rods, 0.25×3-mm ribbons, and 0.4-mm wires. The superconducting transition temperature is about 13°K. The critical current density, J_c, at 4.2°K and zero field is as high as 2.9×10^4 A/cm^2 and decreases to 2×10^3 A/cm^2 at 60 kG. J_c was found to decrease only slightly with temperature up to 9°K. (auth)

23782 REDUCTION OF AC LOSSES OF Nb_3Sn BY SURFACE TREATMENT. Bussière, J.F.; Suenaga, M. (Brookhaven National Laboratory, Upton, New York 11973). J. Appl. Phys. 47: No. 2, 707-714 (Feb 1976).

Large reductions in the ac losses of Nb_3Sn were obtained by surface treatment of thick layers of Nb_3Sn formed by reacting Nb-1% Zr with liquid tin. The surface treatments studied were chemical etching, electropolishing, and mechanical polishing. The significant reduction in the losses is attributed to the removal, by polishing, of a porous outer layer of Nb_3Sn which forms at the Nb_3Sn–liquid-Sn interface and extends into the material. The porosity of this layer results in low surface and bulk current densities (hence high losses) compared to the material further away from the surface. Low losses (~1 μW/cm^2 at 500 rms A/cm) can be obtained by fine mechanical polishing, electropolishing, or chemical etching of the surface. Mechanical polishing can produce the smoothest surfaces but introduces damage beneath the surface which is detrimental to achieving very low losses. When this damaged layer is either etched away or annealed, however, the losses can be made smaller than 1 μW/cm^2 at 500 rms A/cm. The lowest losses were obtained by annealing after rather coarse mechanical polishing. This behavior is attributed to the creation of new pinning centers near the surface after cold working and annealing. (auth)

23783 MAGNETORESISTANCE AND FIELD-INDUCED PHASE TRANSITIONS IN THE HELICAL AND CONICAL STATES OF HOLMIUM. Akhavan, M.; Blackstead, H.A. (Department of Physics, University of Notre Dame, Nortre Dame, Indiana 46556). Phys. Rev. B 13: No. 3, 1209-1215 (1 Feb 1976).

Magnetoresistance measurements on single crystals of holmium are reported for the helical antiferromagnetic and conical ferromagnetic phases. Longitudinal and transverse measurements were made with the magnetic field applied in the *a*, *b*, and *c* planes, including nine different field-current configurations. Data with the current parallel to the *c* direction and the applied field parallel to the easy *b* direction showed the magnetoresistance to be as large as 40%. Basal-plane resistance anomalies have been observed, which when compared to magnetostriction, magnetization, and neutron-diffraction data can be correlated with field-induced transitions, permitting the construction of schematic *H*-*T* phase diagrams. The results of these measurements are in good general agreement with previous work, with the exception that evidence for an additional stable intermediate state has been obtained The basal-plane data were isotropic with respect to the current direction, and highly anisotropic with respect to the direction of the applied magnetic field. In order to observe sharp resistance anomalies, it was essential to mount the samples in such a way as to provide for relief of thermal and magnetostrictive stresses. All samples studied were in the form of thin disks, with the magnetic field applied in the plane of the disk to minimize the demagnetizing effects. (auth)

23784 ULTRASONIC STUDY OF TERBIUM IN A MAGNETIC FIELD. Maekawa, S.; Treder, R.A.; Tachiki, M.; Lee, M.C.; Levy, M. (University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). Phys. Rev. B 13: No. 3, 1284-1298 (1 Feb 1976).

A model is presented which describes longitudinal ultrasonic propagation characteristics in magnetic materials. The model specifically incorporates magnetoelastic and exchange interactions when an external magnetic field is applied. Spin fluctuations and spin polarization are seen to play a dominant role, and particular attention is focused on the effect of critical fluctuations near the magnetic-phase-transition temperatures. The model is applied to single-crystal terbium. Longitudinal ultrasonic attenuation data are presented under conditions of constant temperature and constant magnetic field. The constant-temperature data reveal a very large attenuation enhancement by a magnetic field in the paramagnetic region. The constant-field data show anomalous attenuation maxima even when the applied field is sufficient to quench the spin-spiral state; a magnetic phase diagram for terbium is deduced from the constant-field data. A quantitative comparison between the experimental results and theory is presented for the constant-temperature data, and a qualitative comparison between experimental results and theory is presented for the constant-field data. Good agreement is achieved. (auth)

23785 RAMAN SPECTRUM OF GADOLINIUM MOLYBDATE AT 80°K. Ganguly, B.N.; Ullman, F.G.; Kirby, R.D.; Hardy, J.R. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68508). Phys. Rev. B 13: No. 3, 1344-1352 (1 Feb 1976).

Lines that overlap from thermal broadening in the room-temperature Raman spectrum of gadolinium molybdate are resolved in the 80°K spectrum. A total of 126 of the possible 201 lines have been resolved. Symmetry assignments are derived from considerations of both point symmetry and polariton dispersion, supported by separate measurements of A_1(TO) and A_1(LO) spectra. The splitting of the unstable 47 cm^{-1} room-temperature A_1(TO) line into a doublet at 44.5 and 51.5 cm^{-1}, observed previously only in ir absorption, is also observed in these spectra. On heating, the 44.5-cm^{-1} line remains fixed in frequency whereas the 51.5-cm^{-1} line broadens and shifts toward lower frequency until, above 210°K, the 44.5-cm^{-1} line is obscured. Another A_1(TO) line, peaking at 83 cm^{-1} at 80°K, shifts toward lower frequency on heating, reaching 75 cm^{-1} at room temperature and remaining at that value on further heating up to the transition at 159°C where it becomes Raman inactive. The broadening of the 51.5-cm^{-1} line in the A_1(LO) spectrum is less pronounced so its correlation with the modes of the high-temperature phase can be determined unambiguously. These three lines are suggested to be associated with a system of three coupled modes, whose behavior is discussed, qualitatively, in terms of

energy transfer between modes and damping via a two-phonon decay involving an optic phonon of about 44.5 cm^{-1} and a long-wave acoustic phonon. (auth)

23786 DIFFUSION OF HYDROGEN IN TANTALUM STUDIED BY MOTIONAL NARROWING OF MÖSSBAUER LINES. Heidemann, A.; Kaindl, G.; Salomon, D.; Wipf, H.; Wortmann, G. (Physik-Department der Technischen Universität München, D-8046 Garching, Germany). Phys. Rev. Lett. 36: No. 4, 213-216 (26 Jan 1976).

The effects of H in Ta metal on the isomer shift and linewidth of the 6.2-keV Mössbauer resonance of ^{181}Ta have been studied as a function of H concentration and temperature. From the results, values for the activation energy of the H diffusion and for the mean residence time of the H atoms in Ta are derived. (auth)

23787 PRESSURE DERIVATIVES OF THE ELASTIC MODULI OF NIOBIUM AND TANTALUM. Katahara, K.W.; Manghnani, M.H. (Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822); Fisher, E.S. J. Appl. Phys. 47: No. 2, 434-439 (Feb 1976).

The pressure derivatives of the adiabatic elastic moduli of single-crystal Nb and Ta have been measured ultrasonically at 25°C. The results are in good agreement with shock compression data but differ, particularly for Nb, with previous ultrasonic work. Experimental evidence is presented which indicates that the discrepancy in results may be due to nonideal specimen-transducer geometries which cause an apparent dependence of the observed pressure derivatives on the ultrasonic carrier frequency. (auth)

23788 MELTING CURVE OF RHENIUM UP TO 80 KBAR. Vereshchagin, L.F.; Fateeva, N.S.; Magnitskaya, M.V. (Institute of High-Pressure Physics, USSR Academy of Sciences). JETP Lett. 22: No. 4, 106-106 (20 Aug 1975).

We measured the melting curve of rhenium by an optical method up to 80 kbar. The curve rises somewhat with increasing pressure, from 3450°K at atmospheric pressure to 3770°K at 80 kbar. (auth)

23789 TEMPERATURE DEPENDENCE OF THE MAGNETORESISTANCE OF CADMIUM AND ANTIMONY WHISKER CRYSTALS. Gaĭdukov, Yu.P.; Golyamina, E.M.; Danilova, N.P. (Moscow State University). JETP Lett. 22: No. 4, 107-108 (20 Aug 1975).

The dependence of the magnetoresistance of cadmium and antimony whisker crystals on the temperature was measured in the interval 4.2–80°K. An anomalous increase of the magnetoresistance with increasing temperature was observed. This anomaly is attributed to the presence of specular reflection of conduction electrons from the surfaces of the metals. (auth)

23790 SPECIFIC HEAT OF W, Mo, AND Nb NEAR THEIR MELTING POINTS. Fedorov, V.B. (Moscow). High Temp. 13: No. 3, 608-609 (May 1975).

The specific heat of W, Mo and Nb were obtained from a solution of the heat-balance equations of a long thin bar. A nonlinear variation was found near the melting points of the metals. (AIP)

23791 ANALYSIS OF THE DISTRIBUTION OF DEFECTS IN A TWO-STAGE TIGHT BINDING MODEL FOR Al–In ALLOYS. Epperson, J. E.; Fuernrohr, P.; Gerold, V. (Univ., Stuttgart). Acta Metall.; 23: No. 11, 1381-1387 (1975).

It has been shown previously that the isochronal recovery of dilute binary alloys of In in Al is consistent with the concept of a two-stage tight binding model which, in its simplest form, assumes the existence of single vacancies, isolated impurity atoms, bound mixed pairs, and triplets consisting of two vacancies and one impurity atom. The expressions relating the equilibrium concentrations of these defects are solved, and the two measured binding energies are used to calculate the distributions of defects as a function of total impurity and vacancy content of the alloy and of temperature. Comparison of the form of these calculated distributions with the pertinent isochronal recovery stages observed in dilute alloys of In in Al is quite satisfactory and, hence, is taken as supporting evidence that the model is a valid representation of dilute alloys of this and similar systems in which there is a strong interaction between vacancies and impurity atoms.

23792 INFLUENCE OF CRYSTALLOGRAPHIC ORIENTATION ON FATIGUE CRACK GROWTH IN STRONGLY TEXTURED Ti–6Al–4V. Bowen, A. W. (Royal Establishment, Farnborough, Eng.). Acta Metall.; 23: No. 11, 1401-1409 (1975).

Fractographic features of fatigue crack growth in a strongly textured Ti–6Al–4V bar were studied in order to correlate these features with the orientation of crystallographic deformation modes. The observations fell into two groups: flat fracture surfaces and striations normal to the overall crack growth direction when m values in the Paris equation were low (approximately 2.5); and ridged fracture surfaces and striations at various angles to the overall crack growth direction when m values were high (3.1–4.1). A consideration of the active deformation modes, [1010] slip and [1121] twinning, showed that only when deformation occurred symmetrically about the tip of the crack plane, and thus satisfied the continuum flow field set up in plane strain, did stable fatigue crack growth occur (low m values). Higher growth rate dependences on DELTA K occurred as a result of asymmetric deformation about the crack tip by fatigue crack growth on a number of different fronts, sometimes arising due to (1123) slip, and monotonic fracture processes.

23793 TERNARY EQUILIBRIA IN BISMUTH–INDIUM–LEAD ALLOYS. Liao, K. C.; Johnson, D. L.; Nelson, R. C. (Univ. of Nebraska, Lincoln). Mater. Res. Bull.; 10: No. 11, 1225-1230 (Nov 1975).

The liquidus surface is characterized by three binary equilibria. One binary extends from the Pb–Bi peritectic to the Pb–In peritectic. The other two extend from In–Bi eutectics, merge at 50 at. percent Bi and 30 at. percent Pb, and end at the Bi–Pb eutectic. Based on analysis of ternary liquidus contours and vertical sections, it is suggested that solidification for high lead and very high indium alloys occurs from two-phase equilibria. Solidification from all other alloys occurs from three-phase equilibria. Four-phase solidification does not occur in this system. (auth)

23794 HIGH-FIELD GALVANO- AND THERMOMAGNETIC EFFECTS IN CADMIUM. Fletcher, R. (Queens Univ., Kingston, Ont.). J. Low Temp. Phys.; 22: No. 1/2, 39-59 (Jan 1976).

Results are presented of investigations on the galvano- and thermo-magnetic coefficients of pure Cd (rho_{11}, rho_{21}, $gamma_{11}$, and $gamma_{21}$). The transverse resistivity rho_{11} is almost perfectly quadratic in magnetic field ($B^{1.99}$) at the lowest temperatures, thus throwing doubt on the applicability of intersheet scattering models, which suggest significant departures from B^2. The lattice conductivity lambda/sub g/ is extracted from the high-field thermal data and is found to exhibit no pronounced anomalies, in contrast to the previously obtained data on the zero-field electronic thermal conductivity (to which lambda/sub g/ should be related in the simplest theory). The Hall resistivity rho_{21} is qualitatively similar to that obtained by previous workers, but the detailed field dependence is different. After corrections are made for the effects of lambda /sub g/, the Righi–Leduc thermal resistivity $gamma_{21}$ is found to behave like rho_{21}, though it is more sensitive to temperature, as might be expected for a thermal coefficient. 13 figures. (auth)

23795 ANISOTROPY OF H/sub c2/ AND ITS IMPLICATIONS TO GRAIN-BOUNDARY FLUX PINNING IN V_3Si. Kramer, E. J.; Knapp, G. S. (Argonne National Lab., IL). J. Appl. Phys.; 46: No. 10, 4595-4596 (Oct 1975).

The anisotropy of H/sub c2/ was measured in a V_3Si monocrystal and was found to be much larger than in other materials. The max elementary pinning force f/sub p/ is estimated to be approximately 0.01 dyn/cm at the reduced field H/H/sub c/ equals 0.25 and 4.2°K. Control of texture as well as of grain size is important for improving J/sub c/ in A-15 compounds. (DLC)

23796 PLASTIC FLOW STRESS OF METALS AND ALLOYS IN THE SUPERCONDUCTING AND NORMAL STATES. Hutchison, T. S.; McBride, S. L. (Royal Military Coll. of Canada, Kingston, Ont.). J. Low Temp. Phys.; 22: No. 1/2, 121-139 (Jan 1976).

The observed difference in plasticity in the normal and superconducting states in metals and alloys has been attributed by most authors to an electron–dislocation interaction. Granato has associated this interaction with a dislocation damping property. A different model is suggested, in which the dislocation is thermally activated over a barrier whose effective temperature is raised by dislocation kinetic energy and which cools at a rate dependent on the thermal conductivity. State differences in flow stress are then attributed to differences in conductivity. While previous models have been used to describe the temperature dependence of the flow stress difference alone, this paper describes several other aspects of the phenomenon which demonstrate the validity of the model. (auth)

23797 MAGNETIC FIELD DEPENDENCE OF THE MICROWAVE SURFACE RESISTANCE OF PURE NIOBIUM. Segal, H. R.; McLean, W. L. (Rutgers-the State Univ., New Brunswick, NJ). J. Low Temp. Phys.; 22: No. 1/2, 141-156 (Jan 1976).

The microwave surface resistance of pure niobium was measured in magnetic fields up to H/sub c3/. The surface resistance in the mixed state was found to depend strongly on the mean free path, in contrast to the earlier theory of Caroli and Maki but in agreement with the recent theoretical work of Cerdeira, Houghton, and Maki. Estimates of the constant of proportionality in the mean-free-path dependence are limited in accuracy by the present uncertainty in the values of $kappa_2(T)$. Agreement with the mean free path dependence predicted by the recent theory could not be achieved by incorporating measurements above H/sub c2/ into a simple layer model to adjust the measured values of the surface

resistance with the steady field parallel to the surface. However, the discrepancy between the predicted and measured anisotropies was reduced by this procedure. Other aspects of the experimental results that fall outside the range of validity of the recent theory are compared with general features established by earlier experimental and theoretical work on impure type II superconductors. In particular, the anisotropy of the surface resistance in fields just below H/sub c3/ was found to be temperature independent, as predicted by Thompson and confirmed by Monceau and Waysand. The observed magnetic hysteresis effects in the mixed state are discussed in relation to the nascent vortex model and to the existence of an oxygen-rich surface layer. (auth)

Radiation Effects

Refer also to abstracts 23677 and 25138.

23798 (AED-CONF-75-170-011) TEMPERATURE-DEPENDENT EQUILIBRIUM VALUES OF THE RESIDUAL RESISTANCE OF A Ni-Cu ALLOY. Poerschke, R.; Wollenberger, H. (Kernforschungsanlage Juelich G.m.b.H., Aachen (F. R. Germany). Van de Graaff-Labor). 1975. 6p. (In German). INIS.

From general meeting of the Deutsche Gesellschaft fuer Metallkunde e.V.; Nuernberg, F. R. Germany (20 May 1975).

With figs.

The possibility of a miscibility gap in the Cu-Ni system is discussed on the basis of publications by various authors. The experiments reported were aimed at achieving equilibrium states below 620°K with the aid of radiation-induced diffusion. The results, i.e., the specific resistivity of the specimen as a function of electron irradiation dose and temperature, are presented in charts. Negative changes of resistivity in a Ni-Cu alloy with quasi-statistical distribution are interpreted in terms of increasing segregation. Up to 400°K, the specific resistivity varies parallel to the temperature. An estimation of the atom jumps required in reaching the equilibrium values leads to the only possible interpretation of a short-distance segregation in accordance with neutron diffraction experiments. This would mean that the upper limit of the hypothetic miscibility gap is below 400°K. (DE)

23799 (AERE-R-7974) COMPARISON OF 4.2 MeV Fe^{+} AND 46.5 MeV Ni^{6+} ION IRRADIATION FOR THE STUDY OF VOID SWELLING. Blamires, N. G.; Worth, J. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1975. 21p. Dep. NTIS (US Sales Only) $3.50 UK £ 1.00.

Void formation in pure nickel and 316 steel containing 10 ppM He was studied using 4.2-MeV Fe^{+} ions from the Harwell Van de Graaff accelerator. The dose dependence of swelling in nickel at 525°C and the dose and temperature dependence of swelling in 316 steel is reported. Results are compared with those of other workers, especially those using 46.5-MeV Ni^{6+} ions. In general, there is good agreement, except for a marked decrease in swelling of 316 steel at 650 and 700°C compared with the Ni^{6+} bombardment. Reason for this is thought to result from the restricted width of the damaged region in the low energy case which at the high temperatures is comparable with the inter-void spacing. Anomalous void distributions adjacent to grain boundaries are reported and are probably caused by grain boundary movement. Denuded zones at grain boundaries in 316 steel vary in width from ~ 1300 Å at 450°C to ~ 8800 Å at 700°C. The region adjacent to the surface of the nickel specimens exhibits an abnormally high swelling. Possible explanations are suggested. (auth)

23800 (CEA-R-4695) CONTRIBUTION BY DIGITAL SIMULATIONS TO THE THEORY OF IRRADIATION EFFECTS IN CRYSTALLINE SOLIDS. Dang Dinh Cung. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). 1975. 191p. (In French). Dep. NTIS (US Sales Only) $7.50.

Thesis. Submitted to Univ., Nancy.

Digital simulations were used in a study of the irradiation effects in crystalline solids. With the multiple interaction model, it was found that the model gives a result slightly different from GIBSON and col.'s and is very sensitive to the interatomic potential model. With a light thermal vibration, focusing remains, but the notion of focusing factor as defined by SEITZ has no more significance. With the two-body model, it was found that the irradiation effects in crystalline solids have laws analogous to those of irradiation effects in an amorphous solid but with parameters which have to be modified to take in account of the lattice effects (focusing and channeling). Factorial analysis of the simulation results shows that these results depend on the interatomic potential model which is chosen and that they depend only on the existence or on the non-existence of thermal vibrations and not on the vibration amplitude. (auth)

23801 (CONF-741040-P2, pp 255-262) IMPLANTATION INTO METALS: COMPOUND FORMATION AND DAMAGE PRODUCTION. Myers, S. M. (Sandia Labs., Albuquerque, NM). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

Ion implantation in metals can be used in two ways: first, for the modification of composition in the near-surface region of a solid, where it is uniquely capable of producing states not achievable by equilibrium means; and second, for the controlled introduction of damage. Qualitative differences from the more well-developed area of implantation in semiconductors include the greater degree of annealing of defects in metals and the much higher fluence levels which are of interest. Basic research on the implantation process in metals generally is concerned with one or more of three phenomena: the lattice location occupied by implanted ions when the temperature is low enough to prevent agglomeration; characterization of precipitation processes at higher temperatures; and effects produced by implantation damage. Experiments directed toward applications show great potential for fabrication of superconductors, modification of the corrosion and mechanical properties of surfaces, studies of metallic diffusion and alloying, and simulation of reactor radiation effects.

23802 (COO-1367-72) IRRADIATION SOFTENING IN PURE IRON SINGLE CRYSTALS. Meshii, M. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Materials Science and Engineering). 1975. 14p. (CONF-750952-4). Dep. NTIS $3.50.

From seminar on radiation-produced defects and defect clusters and their effects in metals; Ames, Iowa, USA (28 Sep 1975).

The characteristics of irradiation softening in Fe were studied. Results show that irradiation softening effect can be explained by the intrinsic mechanism, namely, the interaction of screw dislocations with randomly dispersed interstitials. At least some of the solid solution softening phenomena observed in alloys can be explained by the same mechanism. However, the alloying may be accompanied by an additional effect such as solute segregation to dislocations which may also strongly affect the yield stress. This effect may mask the softening effect partially or totally. Changes in the dislocation structure of deformed specimens caused by alloying, which are often reported in electron microscopic investigations, support this contention. The alloying, therefore, may not be as good as the low temperature irradiation in studying the effect of random solutes on dislocation motion and yield stress. (auth)

23803 (HEDL-SA-655) EFFECT OF SILICON ON MICROSTRUCTURE OF NEUTRON IRRADIATED TYPE 316 STAINLESS STEEL. Brager, H. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1974. Contract E(45-1)-2170. 21p. (CONF-740651-8). Dep. NTIS $3.50.

From symposium on the effects of radiation on structural materials; Gatlinburg, Tennessee, USA (11 Jun 1974).

Solution-treated AISI 316 SS containing 0, 0.5, 1, 1.5, and 2 wt percent Si was irradiated in EBR-II to low fluences of 2 to 4 x 10^{22} and examined by transmission electron microscopy. Results are: The absence of Si (less than 0.01 percent) greatly decreases the swelling resistance by enhancing void nucleation. At 405°C, increasing the Si content decreases swelling by inhibiting void nucleation, while at 610°C, a complex relation exists between swelling and Si content due to heterogeneous void formation and its association with second-phrase precipitates. (DLC)

23804 (HEDL-TME-75-95) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Semiannual Progress Report, March 1975–July 1975. Claudson, T. T. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-2170. vp. Dep. NTIS $11.75.

Mechanical properties and irradiation effects are reported by Aerojet, ANL, AI, GE, HEDL, NRL, ORNL, PNL, and Univ. of Cincinnati for: Type 304, 304L, and 316 stainless steels; Inconel 718; nickel; Ni alloys; V alloys; Mo; Nb; and Nb-1 Zr. (DLC)

23805 (IEA-391) DAMAGE PRODUCTION BY FAST ELECTRONS IN DILUTE ALLOYS OF VANADIUM, NIOBIUM, AND MOLYBDENUM. Jung, P.; Lucki, G. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1975. 16p. Dep. NTIS (US Sales Only) $3.50.

Vanadium, niobium and molybdenum samples containing about 300 ppM of zirconium were irradiated at helium-temperature with electrons of energies between 0.6 and 3.1 MeV. The mea-

sured damage rates were analyzed in terms of minimum threshold energy, damage function, and resistivity per unit concentration of Frenkel pairs. For the minimum threshold energy T_d, values of 25 ± 2 eV (V), 28 ± 2 eV (Nb) and 34 ± 2 eV (Mo) were obtained. Pronounced differences between the displacement functions of molybdenum and that of niobium and vanadium are found which are explained by different stability of the defects during the irradiation at helium temperature. (auth)

23806 EFFECTS OF LARGE CONCENTRATIONS OF HELIUM ON THE MECHANICAL PROPERTIES OF NEUTRON-IRRADIATED STAINLESS STEEL. Bloom, E. E.; Wiffen, F. W. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 58: No. 2, 171-184 (Nov 1975).

Tensile and creep properties have been determined on specimens of type 316 stainless steel irradiated in the High Flux Isotope Reactor in the range 380 to 785°C. Irradiation of type 316 in this reaction partially simulates fusion reactor irradiation, with displacement damage levels up to 120 dpa and helium contents up to 6000 appM achieved in two years. Samples irradiated in the annealed condition to about 100 dpa and 4000 appM helium showed an increased yield strength between 350 and 600°C and, except at 350°C, a reduced ultimate tensile strength compared with values for the unirradiated material. Samples irradiated in the 20 percent-cold-worked condition showed decreases in both yield and ultimate tensile strengths at all test temperatures. The irradiated samples of both annealed and cold-worked material exhibited little strain hardening. Total elongations were small and became zero for tests at 650°C. Tensile tests at 575°C and creep-rupture tests at 550°C showed strong effects of fluence on strength and ductility for helium contents above about 30 appM. Optical metallography showed extensive carbide precipitation at all temperatures and precipitation of a second phase, believed to be sigma, at the high temperatures. (NL)

23807 IRRADIATION EMBRITTLEMENT OF NUCLEAR REACTOR VESSEL STEELS. Petrequin, P.; Soulat, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). APAVE Rev.; 56: No. 191, 35-49(Jul 1975). (In French)

The mechanisms responsible for irradiation embrittlement of steels are recalled. The effects of the irradiation temperature, neutron doses, metallurgical structure and chemical composition of materials are discussed. The results obtained on a reactor vessel steel A533-B are presented. (FR)

23808 IRRADIATION-INDUCED VACANCY INJECTION AT SURFACES AND ITS EFFECT ON THE SATURATION OF VOID SWELLING. Nelson, R. S. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 57: No. 1, 77-81(Jul 1975).

Dynamic vacancy injection into a solid due to the intersection of replacement-collision sequences with surfaces is discussed in the context of the production of voids in metals during irradiation. The basic equations governing the growth of voids in such an environment are derived in the context of the rate theory of swelling. Depending upon the parameters chosen, the model predicts a saturation in the void radius and hence a saturation in swelling. The predictions are compared with observations in order to empirically evaluate the vacancy injection parameter. Finally, the conditions under which saturation is most likely to occur are briefly discussed. (NL)

23809 VACANCY CLUSTER DAMAGE IN TYPE 316 STAINLESS STEEL IRRADIATED WITH Cr^+ IONS. English, C. A.; Eyre, B. L.; Shoaib, K.; Williams, T. M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 58: No. 2, 220-226(Nov 1975).

An electron microscope study has been made of damage in Type 316 stainless steel irradiated to low doses at room temperature with 40, 80, 120, and 200 keV Cr^+ ions. The visible clusters are dissociated Frank loops and stacking fault tetrahedra and it is deduced that they are vacancy in nature having formed by collapse of displacement cascades. Quantitative analysis of the structures has shown that the defect yield and cascade efficiency are approximately independent of incident ion energy and are much lower than in self-ion irradiated pure copper. This and the fact that reducing the level of carbon in solution in the stainless steel increases the cascade efficiency is attributed to the role played by the alloy elements and impurities in defocusing focussed collision sequences and thereby enhancing interstitial-vacancy recombination in cascades. Lastly, the present results are considered in terms of their implication to the formation and growth of voids during irradiation of Type-316 stainless steel at elevated temperatures. (NL)

23810 DAMAGE FUNCTION ANALYSIS. McElroy, W. N. (Hanford Engineering Development Lab., Richland, WA); Simons, R. L.; Doran, D. G.; Odette, G. R. J. Test. Eval.; 3: No. 3, 220-229(May 1975).

From ASTM minisymposium on neutron dosimetry and spectrum analysis for materials applications; San Diego, CA (3 Dec 1974).

The current status and procedures associated with damage function analysis as it applies to the development, design, and operation of nuclear reactors are reviewed. Damage function analysis provides a systematically applied engineering approach for estimating fluence limits and their uncertainties for neutron-induced property changes for reactor materials and components. A summary of derived, quasi-empirical damage functions is provided and emphasis is placed on the need for standardization in their definition and application. Included is a discussion of the calculation and use of displacement production as an energy-dependent measure of exposure and displacement cross sections for damage function analysis. A brief review is given of the current and projected status of the neutron flux-fluence spectra characterization that is essential for damage function analysis. (auth)

23811 RADIATION DAMAGE UNITS FOR STEEL. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh). J. Test. Eval.; 3: No. 3, 230-237(May 1975).

From ASTM minisymposium on neutron dosimetry and spectrum analysis for materials applications; San Diego, CA (3 Dec 1974).

Damage units are needed to correlate radiation effects data from different types of radiation sources and to standardize experimental and testing procedures. In the case of radiation-induced changes in the mechanical properties of structural materials, useful damage units are the production rates per unit volume of mobile defects, immobile defect clusters, and interstitial dislocation loops. Quantitative recipes are given for the production of these and other related defects in steel at reactor operating temperatures. (auth)

23812 ELECTROMAGNETIC RADIATION- AND TEMPERATURE EFFECT ON THE ELECTRIC RESISTANCE OF DEFORMED MOLYBDENUM. Dekhtyar, I. Ya.; Danil'chenko, B. A.; Chirko, I. L.; Shalaev, A. M. (AN Ukrainskoj SSR, Kiev. Inst. Metallofiziki; AN Ukrainskoj SSR, Kiev. Inst. Fiziki). Metallofizika; No. 50, 86-89(1974). (In Russian).

Changes in electrical resistance of torsion-deformed (5, 10, and 25%) and gamma-irradiated (^{60}Co source, 10^9R) molybdenum after low-temperature annealing (100-140°C) were studied. The electrical resistance decreased during the annealing. The curve of change in electrical resistance with annealing of irradiated samples approached saturation, which agrees with theoretical assumptions of the focuson theory. The observed changes indicated relaxation of internal tensions in homogeneously deformed samples. (tr-auth)

23813 LONG-RANGE MIGRATION OF SELF-INTERSTITIAL ATOMS IN TUNGSTEN. Dausinger, F.; Schultz, H. (Institut für Theoretische und Angewandte Physik der Universität Stuttgart, Stuttgart, Bundesrepublik Deutschland). Phys. Rev. Lett. 35: No. 26, 1773-1775 (29 Dec 1975).

Resistivity annealing following irradiation with 3-MeV electrons at 4.5 K has been investigated on tungsten single crystals. High-purity samples showed a recovery stage between 24 and 30 K, which apparently shifts with increasing dose to lower temperatures. We conclude that it is associated with long-range migration of self-interstitial atoms with a migration energy of 54±5 MeV. The relationship to recent conclusions of other authors is discussed. (auth)

23814 DEPTH-RESOLVED CATHODOLUMINESCENCE OF ION-IMPLANTED LAYERS IN ZINC OXIDE. Pierce, B.J. (Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio 45433); Hengehold, R.L. J. Appl. Phys. 47: No. 2, 644-651 (Feb 1976).

Single-crystal substrates of ZnO prepared from a large boule of hydrothermally grown material were implanted with ions of Li, Na, N, P, and Ne using energies in the range 30 keV–1 MeV and doses of 1×10^{11}–1×10^{16} ions/cm^2 using substrates maintained at either room temperature or 475 °C. These implanted layers were studied using depth-resolved cathodoluminescence. The spectra obtained agreed well with those expected based on a comparison of theoretical electron-hole pair profiles and computer-generated ion implantation profiles. The spectra of all samples implanted at 475 °C exhibited a peak near 6500 Å, and a series of previously unreported phonon-coupled peaks analogous to the well-known CdS "edge" emission was observed to some extent in all the implanted samples, independent of implant species. The luminescence could be quenched by annealing above 600 °C and is probably a result of the formation of damage centers. (auth)

23815 POINT DEFECT BEHAVIOUR IN IRRADIATED MATERIALS. Heald, P. T.; Speight, M. V. (Berkeley Nuclear Labs., Eng.). Acta Metall.; 23: No. 11, 1389-1399(1975).

When nonfissile materials are bombarded with energetic particles, large numbers of vacancies and interstitials are produced. The subsequent behavior of these point defects is responsible for the observable phenomena of swelling and enhanced creep. A comprehensive theory of the defect interactions and kinetics leading to swelling and creep was developed. Particular attention was given to determining the densities of point defect sinks, both dislocations and voids, and their dependence on the irradiation temperature. The dislocation preference for the capture of interstitials is a strong function of the irradiation temperature and not constant as is frequently assumed. The swelling and creep rates predicted by the theory are shown to be in accord with the experimental results. (auth)

23816 EFFECTS OF ELECTRON IRRADIATION ON PRECIPITATION IN Al–3.5 PERCENT Cu. Sklad, P. S.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). Acta Metall.; 23: No. 11, 1287-1302 (1975).

The effects of electron irradiation on precipitation in Al–3.5 percent Cu was studied in the temperature range 20–200°C by high voltage electron microscopy. G. P. zones gradually disappear during irradiation and are replaced by theta' precipitates. The intermediate stage of theta'' precipitation is inhibited by irradiation. If theta'' precipitates are introduced by preaging, they are also gradually replaced by theta' precipitates during irradiation, even in the temperature range where they would normally grow. The growth of theta' precipitates is observed to be enhanced at all temperatures between 20 and 200°C (above 200°C the growth rate is normal), especially at the lower temperatures. In fact, the growth rate is approximately constant between 20 and 120°C where essentially no growth is observed under normal aging. These results are explained in terms of a model of enhanced diffusion resulting from the annihilation at fixed sinks of the vacancies and interstitials created by irradiation; the fixed sinks are the precipitates themselves. The irradiating conditions in the microscope are shown to give rise to a constant contribution to the diffusion coefficient, D/sub rad/ approximately equal to 2×10^{-16} cm^2 s for the temperature range 20–120°C. Irradiation also gives rise to small dislocation loops in either the quenched or the aged condition, but these are only observed at room temperature. Voids are never observed; apparently, the precipitates act as sinks for both the vacancies and interstitials. (auth)

Other Materials

Refer also to abstracts 22742, 22778, 23068, 23662, 23704, 23715, 23726, and 23738.

23817 (AERE-R–8092) RADIATION DAMAGE IN DIATOMIC MATERIALS AT HIGH DOSES. Hobbs, L. W.; Hughes, A. E. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1975. 27p. (CONF-750542–8). Dep. NTIS (US Sales Only) $4.00. UK £ 1.00.

From 77th annual meeting of the American Ceramic Society; Washington, District of Columbia, USA (3 May 1975).

Radiation effects in diatomic materials can differ structurally from those in metals because of the need to take into account different displacement rates on the two sublattices and the inevitable stoichiometric implications; in most diatomic insulators the anion species has the greater displacement cross section. Anion point defect stabilization in heavily irradiated (0.1–10 dpa) diatomic insulators has been studied using radiolysis of alkali and alkaline earth halides. At temperatures > 0.3 T_m, all anion defects are mobile and can aggregate. Aggregation of anion interstitials results in creation of perfect dislocation loops without the need for primary cation displacements; simultaneous formation of substitutional anion molecular centers provides the necessary cation interstitials. Aggregation of anion vacancies leads to formation of metallic inclusions of the cation species, in some cases in an ordered array, which is the analogue, on a single sublattice, to the void lattice in metals. Availability of sinks for both anion interstitials and anion vacancies yields defect growth kinetics similar to those observed during formation of voids in irradiated metals, and a very high level of damage (~ 10%) can be sustained in the lattice. The width of the temperature region concerned is much narrower, however, due to the possibility of recombination of aggregated or re-emitted anion vacancies with mobile or dispersed anion molecular defects; the latter can also aggregate to form fluid anion molecular inclusions and so complete the decomposition of the solid into separate phases of its constituent elements. (45 references, 14 fig) (auth)

23818 (IKE-5-189-D) THEORETICAL AND EXPERIMENTAL STUDIES ON THE THERMAL CONDUCTIVITY OF POROUS MATERIALS. Kuttruf, H.; Klumpp, W.; Neuer, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Mar 1975. 51p. (In German). INIS.

8 refs.; with figs. and tabs.

The thermal conductivity λ and the thermal diffusivity a are measured between 1,400 and 2,200 K for carbon foam, a good thermal conductor in a vacuum. λ is determined in a stationary process, while a is measured using an unstationary method which has only been used for massive bodies so far. A programme calculating the temperature curve in a porous system is established in order to check the applicability of measuring methods for homogeneous materials. The programme solves the heat equation in consideration of the radiation contributions. The porous body is approached in a model which divides it in massive bridges and regular cavities to achieve the desired porosity. In the bridges, heat is transferred by conduction, in the cavities, by radiation only. The equations derived from this model are solved by the ADI approach. The calculated results are in good agreement with the experiments. (DE)

23819 (LA-6181) EFFECT OF HEAT TREATMENT TEMPERATURE ON BINDER THERMAL CONDUCTIVITIES. Wagner, P. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-eng-36. 4p. Dep. NTIS $4.50.

The effect of heat treatment on the thermal conductivities of a pitch and a polyfurfuryl alcohol binder residue was investigated. Graphites specially prepared with these two binders were used for the experiments. Measured thermal conductivities were treated in terms of a two-component system, and the binder thermal conductivities were calculated. Both binder residues showed increased thermal conductivity with increased heat treatment temperature. (auth)

23820 (NTIS/PS-75/414) BORON REINFORCED COMPOSITES. A Bibliography with Abstracts. Search Period Covered: 1972–May 1975. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). May 1975. 253p. NTIS $25.00.

Reports are cited which cover all uses of boron, especially boron fibers, as a reinforcing material in composites. The topics include fabrication, testing, uses, and structural and mechanical properties. 199 abstracts. (auth)

23821 (ORO-4682-2) SORPTION OF CESIUM BY GRAPHITES AS A FUNCTION OF STRONTIUM AND BARIUM CONCENTRATION AT HIGH TEMPERATURES. Progress Report, February 1, 1975–January 31, 1976. Pyecha, T. D. (North Carolina State Univ., Raleigh (USA)). 1976. Contract AT(40-1)-4682. 32p. Dep. NTIS $4.00.

Cesium desorption isotherms on H-451 graphite were obtained at 800, 900, 1000, and 1100°C. Hysteresis was observed at cesium vapor pressures below 5×10^{-6} atm on the 1000°C isotherm. A cesium background experiment indicated that the sorption tube background contribution is not a major factor in assessing the cesium behavior within the higher vapor pressure range. One strontium desorption experiment was conducted, using H-451 graphite impregnated to 2.28 mu moles Sr/g C. Two sorption experiments on strontium impregnated H-451 graphite (approximately 5 and approximately 1 mu mole/g) are about to begin. From the preliminary analysis of the kinetic behavior, it is concluded that the lengthy times required for the graphite sample to equilibrate (3 to 12 days) is determined by the diffusion of cesium atoms from graphite pore surfaces into the graphite grains. One sorption sample was radially profiled upon completion of a 1000°C sorption experiment, and this profile was analyzed. Concentration-dependent strontium diffusion studies on H-451 graphite have also begun at 1600°K, with an initial uniform strontium concentration of 10 mu g Sr/g C in the first experiment. Electron microprobe qualitative analyses are being conducted on H-451 graphite samples.

23822 (UCID-15850) HIGH PRESSURE MECHANICAL PROPERTIES OF TUGBOAT CORAL. Stephens, D. R.; Heard, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 May 1971. Contract W-7405-Eng-48. 11p. Dep. NTIS $3.50.

Project Tugboat is a chemical explosive excavation experiment designed to (1) provide a light draft boat harbor at Kawaihae Bay, Hawaii, (2) test the applicability of cratering for harbor construction, and (3) provide technical data useful for the design of nuclear harbor excavation experiments. Mechanical properties of the coral-sea water detonation medium was studied in order that calculations could be made of the phenomenology of the event. (DLC)

23823 (UCRL-Trans-10733) LUMINESCENCE OF SOME TRI- AND BI-VALENT RARE EARTHS IN QUARTZ GLASS. Kalenov, A. A.; Kolobkov, V. P.; Kovaleva, I. V.; Starostina, G. P.; Bykov, V. I. 1973. Translation of pp 231-234 from

Spektroskopiya Kristallov, Izdatel'stvo "Nauka," Leningrad, 1973. (CONF-700580-1). 7p. Dep. NTIS $4.50.

From 3rd symposium on crystal spectroscopy, activated by ions of rare earths and transitional metals; Leningrad, Union of Soviet Socialist Republics (USSR) (4 May 1970).

The characteristics of absorption and luminescence of quartz glasses, activated by separate tri- and bivalent rare earths are discussed. (LK)

23824 INFLUENCE OF THE SPHEROIDAL-STATE PHENOMENON ON STATIC PYROCARBON DEPOSITION AT 2100-2300°C. Linke, J.; Koizlik, K.; Luhleich, H.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). J. Nucl. Mater.; 58: No. 2, 233-236(Nov 1975). (In German).

The results are reported of an experimental study of the effect of the formation of thermally insulating vapour layers between substrate and condensing films of pyrocarbon on the properties of the pyrocarbon from the point-of view of its use as a fuel-element cladding material. (NL)

23825 INVESTIGATIONS ON THE TRANSPORT BEHAVIOUR OF STRONTIUM IN COATED PARTICLES AT HIGH TEMPERATURES. Foerthmann, R.; Gyarmati, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). J. Nucl. Mater.; 58: No. 2, 189-195(Nov 1975).

Annealing experiments on non-irradiated coated particles containing small amounts of ^{85}Sr gave the following results: Silicon alloyed pyrocarbon has not improved retention properties compared with pyrocarbon, if its deposition temperature is above 1500°C. At a deposition temperature of 1440°C the diffusion coefficient of Sr in silicon alloyed pyrocarbon is about 5×10^{-12} cm^2s^{-1} at 1400°C. The best Sr retention is obtained by silicon carbide coatings deposited at temperatures between 1500 and 1800°C. Pyrocarbon-coated particles with alumina-silica kernel additives have nearly the same Sr retention properties as silicon carbide-coated particles. (NL)

23826 CODEPOSITED PYROCARBON-SILICON CARBIDE COATINGS FOR NUCLEAR FUEL PARTICLES. Kaae, J. L.; Reynolds, G. H. (General Atomic Co., San Diego, Calif. (USA)). J. Nucl. Mater.; 58: No. 2, 237-240(Nov 1975).

Mixed coatings for fertile fuel particles are currently undergoing extensive evaluation and testing to determine if the potential advantages of the mixed pyrocarbon-silicon carbide coatings can be realized in practice. (NL)

23827 IRRADIATION-INDUCED MICROSTRUCTURAL CHANGES IN ISOTROPIC PYROLYTIC CARBONS. Kaae, J. L. (General Atomic Co., San Diego, Calif. (USA)). J. Nucl. Mater.; 57: No. 1, 82-92(Jul 1975).

Transmission electron microscopy has been used to investigate irradiation-induced microstructural changes in the isotropic pyrolytic carbons which are employed as coatings on the fuel particles used in high-temperature gas-cooled nuclear reactors. In low-density very nearly isotropic carbons densification during irradiation occurs through elimination of an irregular microstructure consisting of twisted and distorted sheets made up of stacks of carbon-layer planes. In high-density slightly anisotropic carbons, where the irregular microstructure is not present, irradiation results in cracking and distortion of the spherical-growth features which make up the carbon, with the cracks producing a decrease in the density. In both, the low-density and high-density carbons, considerable crystallite growth occurs during irradiation as evidenced by large increases in the lengths of extinction contours or diffraction contrast fringes. The increases are larger in the high-density carbons than in the low-density carbons. (NL)

23828 ELECTRICAL CONDUCTIVITY OF SODIUM SILICATE GLASS LAMINATES UNDER BOMBARDMENT BY AR^+ IONS. Chiplonkar, V. T.; Pai, V. A. (Institute of Science, Bombay (India). Ion Physics and Electronics Lab.). J. Non-Cryst. Solids; 18: No. 3, 455-458(Nov 1975).

The electrical conductivity shown by sodium silicate glasses has been considered to be ionic, unipolar and to involve jumps of the network modifying Na^+ mobile ions, between neighbouring interstitial sites normally occupied by them, on account of the applied electric field. (NL)

23829 THE EFFECT OF WATER IN GLASS ON THE QUENCHING OF THE LUMINESCENCE OF THE RARE-EARTH ACTIVATOR. Bondarenko, E.G.; Galant, E.I.; Lunter, S.G.; Przhevuskii, A.K.; Tolstoi, M.N. Sov. J. Opt. Technol. 42: No. 6, 333-335 (June 1975).

It is found that water in glass is an effective quencher of the luminescence of the rare-earth activators Nd^{3+}, Yb^{3+}, Er^{3+}. Widely varying values of the luminescence extinction time τ and quantum yield η can be obtained in a given glass composition, depending on the synthesis conditions, which permit the number of OH groups to vary. These values reach maximums in completely water-free glasses of the same composition. (auth)

23830 EXISTENCE OF TERNARY HYDROGENATED PHASES OF BeP/sub 2-x/H/sub y/. Jean-Francois, B.; Gerardin, R.; El Maslout, A.; Zanne, M.; Courtois, A.; Aubry, J. (Univ., Nancy). Mater. Res. Bull.; 10: No. 11, 1243-1248(Nov 1975).

The phosphidation of beryllium in the presence of traces of hydrogen leads to non stoichiometric ternary phases BeP/sub 2-x/H/sub y/. The stoichiometric diphosphide BeP_2 cannot be obtained. The hydrogenated phases are black and nonhygroscopic. The structural study with x-ray diffraction, neutrons diffraction, electronic microdiffraction, as well as the crystallographic data from single crystal, provide evidence for a quadratic cell with a equals 7.08 A and c equals 30.12 A. The stacking is diamond type when considering all the atoms: Be, P and H. (auth)

23831 NEAR-SURFACE NUCLEATION AND CRYSTALLIZATION OF AN ION-IMPLANTED LITHIA-ALUMINA-SILICA GLASS. Arnold, G. W. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 10, 4466-4473(Oct 1975).

Surface crystallization of a Au^+-ion-implanted lithia-alumina-silica glass was realized. Annealing of a glass sample implanted with 285-keV Au^+ ions at 550°C results in the growth of colloidal Au particles of 18 to 35-A radius. The Au particles constitute sites for the precipitation of lithium metasilicate crystals at 550°C. Further annealing at 750°C allows the growth of quartz and beta-spodumene crystals. The crystallized surface obtained after the high-temperature anneal was characterized by a Knoop microhardness number of 626, which is of the order of that obtained for commercial volume-crystallized glass-ceramics of similar composition. (auth)

23832 RADIATION HARDENING OF OLIGOCARBONATO-METHACRYLATES DIETHYLENEGLYCOL BIS-METHACRYLOXYETHYLENECARBONATE (OCM-2). Barkalov, I. M.; Brikenshtein, A. A.; Gol'danskii, V. I.; Kiryukhin, D. P.; Munikhes, V. M.; Radugina, A. A. (Inst. of Chemical Physics, Moscow). Dokl. Phys. Chem. (Engl. Transl.); 222: No. 4-6, 623-626(Jun 1975).

Translated from Dokl. Akad. Nauk SSSR; 222: No. 4, 1357-1360(Jun 1975).

The hardening process of a novel class of polymerizable oligomers (the oligocarbonatomethacrylates) was investigated. This class of oligomers is distinguished by rapid rates of radiation hardening. The hardening of OCM-2 was initiated by γ rays. Kinetics of the hardening were followed from the heat of evolution by a calorimetric method. (LK)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

23833 (BNWL-1906) REPORT OF THE AD HOC STUDY GROUP ON INTEGRATED VERSUS DISPERSED FUEL CYCLE FACILITIES. Kreiter, M. R.; Platt, A. M. (comps.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1975. 115p. Dep. NTIS $5.50.

To provide isolation of strategic materials and confinement of nuclear wastes, the basic facilities considered in assessing the DFCF and IFCF were mixed plutonium and uranium oxide and HTGR fuel fabrication, fuel reprocessing, high-enrichment isotopic separation and interim waste storage. Reactors, low-enrichment isotopic separation, and low-enrichment uranium facilities were excluded. It is expected that the IFCF would attract uranium fuel fabrication and possibly reactors. An assumption was made for the study that the choice of either IFCF or DFCF would not alter the nuclear power generation pattern postulated to exist up to the year 2000. The advantages of IFCF are seen to outweigh disadvantages. (auth)

23834 (BNWL-1952) NUCLEAR WASTE MANAGEMENT AND TRANSPORTATION QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1975. Platt, A. M. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 51p. Dep. NTIS $5.45.

Progress is reported in the following areas of research: advanced methods for management and disposal of radioactive wastes; decontamination and densification of chop-leach cladding residues; pyrolysis–incineration of combustible alpha wastes; tritium separation and fixation; disposition of retired contaminated facilities at Hanford; and transportation safety studies. (JGB)

23835 (KFK-2022) AMOUNT, DISPOSAL, AND RELATIVE TOXICITY OF LONG-LIVED FISSION PRODUCTS AND ACTINIDES IN THE RADIOACTIVE WASTES OF THE NUCLEAR FUEL CYCLES. Haug, H. O. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Heisse Chemie). Nov 1975. 217p. (In German). Dep. NTIS (US Sales Only) $7.75.

A review is presented on the magnitude of the long-term problems of radioactive wastes from the nuclear power industry of the FRG (and Western Europe). The production of long-lived fission products and actinides has been calculated for several fuel types of the uranium–plutonium and thorium–uranium fuel cycles and related to a prediction of the development and share of LWR, FBR, and HTGR. The quantities and concentrations of actinides, the radioactivity and relative toxicity index of the wastes of reprocessing (and fuel refabrication) and their changes by radioactive decay are presented. The radiotoxicity of the nuclide inventory of the solidified high-level wastes has been compared with naturally occurring uranium ores. On the long term (>10^3 years), the radiotoxicity level of the total area of the final repository in deep geological formation does not result in a significantly higher radiotoxicity level than an uranium ore deposit of low uranium content. Also discussed have been the chemical separation of the actinides from high-level wastes and recycling in fission reactors. (auth)

23836 (PB-240739) THE EFFECTS OF AIR AND WATER POLLUTION CONTROLS ON SOLID WASTE GENERATION, 1971–1985. Executive Summary. Final Report. Stone, R. (Stone (Ralph) and Co., Inc., Los Angeles, Calif. (USA)). Dec 1974. Contract EPA-68-03-0244. 84p. NTIS $4.75.

The effects of air and water pollution controls on solid waste generation were evaluated. The solid wastes from pollution control were identified for individual industrial sectors by their original air or water pollutant constituents, and the treatment process applied. The wastes were categorized by type and by location (rural or urban). Total solid wastes from pollution control activities were estimated for 1971 and projected for 1985. Particulates and sulfur oxides were identified as the major air pollutants capable of generating solid wastes when treated; suspended solids and biological oxygen demand were identified as the principal means of estimating the impact of water pollution control on solid wastes. Important sectors generating solid wastes included power plants, paper and pulp, chemicals, and cement and clay, steel furnaces, nonferrous smelting and refining, sewerage systems, and hazardous wastes from uranium mining. Mine tailing ponds were estimated to be a greater source than all the above sources but were not seen to be a landfill disposal problem. (GRA)

23837 WHAT SHALL WE DO WITH THE WASTE. Ramsey, R. W. Jr. (Energy Research and Development Administration, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 75-91(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A philosophical treatment is presented of the development of a radioactive waste management system for the nuclear fuel cycle. Parallels with safeguards are pointed out. Three elements of management are depicted: isolation or elimination, immobilization or containment, and surveillance or response. It is postulated that any condition of management is definable in terms of these three components. Solidification and the retrievable surface storage facility are discussed. (DLC)

Accountability and Safeguards

Refer also to abstracts 22720, 22721, 22735, 22738, and 23366.

23838 (BNWL-B-474) AUTOMATED DATA ACQUISITION AND ANALYSIS SYSTEM FOR INVENTORY VERIFICATION. Sorenson, R. J.; Kaye, J. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1974. Contract E(45-1)-1830. 30p. Dep. NTIS $4.50.

The RLO Safeguards Branch-conducted nuclear materials inventory verifications of each Hanford contractor are limited by the amount of information and data transcriptions which the inspector can perform, since he is required to manually transcribe all of the data, operate the NDA equipment, and record the information. The data analysis and evaluation lag the actual data acquisition. Therefore, an automated data handling system is needed for the control, acquisition, storage, display, and processing of the data obtained during the verification. A real-time system is proposed which would allow the RLO Safeguards Branch to conduct a meaningful inventory verification using a variety of NDA instruments. The overall system would include the NDA instruments, automated data handling equipment, and a vehicle to house and transport the instruments and equipment. For the purpose of the preliminary cost estimate a specific data handling system and vehicle were required. A Tracor Northern TN-11 data handling system including a PDP-11 minicomputer and a measurement vehicle similar to the Commission's Regulatory Region I van were used. The basic system is currently estimated to cost about $100,000, and future add-ons which would expand the system's capabilities are estimated to cost about $40,000. The concept of using a vehicle in order to permanently rack mount the data handling equipment offers a number of benefits such as control of equipment environment and allowance for improvements, expansion, and flexibility in the system. Justification is also presented for local design and assembly of the overall system. A summary of the demonstration system which illustrates the advantages and feasibility of the overall system is included in this discussion. Two ideas are discussed which are not considered to be viable alternatives to the proposed system: addition of the data handling capabilities to the semiportable "cart" and use of a telephone link to a large computer center. (DLC)

23839 (CONF-741040-P2, pp 209-224) ROLE OF THE SMALL ACCELERATOR IN THE NONDESTRUCTIVE ASSAY LABORATORY. Evans, A. E. Jr.; Atwell, T. L.; Augustson, R. H.; Malanify, J. J.; Menlove, H. O. (Los Alamos Scientific Lab., NM). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

The small accelerator has been a valuable asset for the development of techniques to assay fissionable materials in support of the Nuclear Safeguards Program. In particular, the availability of a 3-MeV Van de Graaff accelerator as a source of neutrons of precisely controllable energy spectrum, intensity, and time duration has made possible the development of extremely reliable assay systems. Cockroft-Walton-type accelerators of both the conventional and sealed-tube types, used as generators of 14-MeV $^3H(d,n)^4He$ neutrons, have also been important in the development of nondestructive assay techniques. Fundamental information obtained from the study of accelerator-based assay systems has also been applied to the development of less expensive, transportable systems which utilize isotopic neutron sources.

23840 (KFK-2206) ANNUAL REPORT, 1974. Bork, G. (comp.). (Kernforschungszentrum Karlsruhe (F.R. Germany). Projekt Spaltstoffflusskontrolle). Dec 1975. 183p. (In German). Dep. NTIS (US Sales Only) $7.50.

A description is presented of major activities performed in 1974 within the framework of the Nuclear Safeguards Project

by the institutes of the Gesellschaft für Kernforschung Karlsruhe participating in this Project, the European Institute of Transuranium Elements, and some industrial firms. (auth)

23841 NUCLEAR MATERIALS SAFEGUARDS AND THE FUEL CYCLE INDUSTRY. Imai, R. (Japan Atomic Power Co., Tokyo). Nucl. Eng. Int.; 20: No. 234, 679-681(Sep 1975).

The attitude of the nuclear industry to safeguards is examined. Ways in which the State may operate in its responsibility for national security through the excercise of good material management and physical protection by the nuclear facilities is discussed and the co-ordinating of national systems with IAEA safeguards is considered. Safeguards technology in relation to individual facilities is discussed and it is emphasized that in certain highly sensitive areas industry will have to accept more control in the future. Problems associated with the expansion of the nuclear industry are discussed. The technical requirements of international safeguards are considered to be similar to those of the state control system but much less in scope, and stem inherently from the nuclear fuel cycle itself. (UK)

23842 NRC SAFEGUARDS AND RELATED ISSUES. Gilinsky, V. (Nuclear Regulatory Commission, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 9-16(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Issues raised by the need for nuclear safeguards are discussed. Existing safeguards measures, improvements, and new measures under consideration are discussed. Guards, security, and the resulting effect on civil liberties are discussed. (DLC)

23843 IAEA INTERNATIONAL SAFEGUARDS AND THE NPT REVIEW CONFERENCE. Rometsch, R. (International Atomic Energy Agency, Vienna). Nucl. Mater. Manage.; 4: No. 3, 17-33 (Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The Non-proliferation Treaty (NPT) and its associated safeguards are discussed. A NPT conference was held in Geneva on May 5 to 30, 1975, and its deliberations are summarized, with discussions of the various articles of the treaty. (8 figs) (DLC)

23844 NUCLEAR SAFEGUARDS: A PERSPECTIVE. Walske, C. (Atomic Industrial Forum, Inc., New York). Nucl. Mater. Manage.; 4: No. 3, 34-42(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Safeguards, both international and domestic, are discussed from the industrial viewpoint. Anti-criminal measures are considered in more detail. Areas of anti-criminal safeguards which need improvement are pointed out; they include communications, recovery force, and accounting. (DLC)

23845 INTERNATIONAL SAFEGUARDS ISSUES: THE U. S. VIEWPOINT. Giller, E. B. (Energy Research and Development Administration, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 43-49(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The background to U. S. policy on international nuclear technology is described, including the Atoms for Peace program. Contributions of U. S. to IAEA are pointed out. Developments in physical security systems are next discussed. It is emphasized that U. S. has no monopoly on the nuclear market and should remain in it while pressing for proper safeguards. (DLC)

23846 NRC SPECIAL STUDIES: A STATUS REPORT. Smiley, S. H. (Nuclear Regulatory Commission, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 64-70(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The Nuclear Energy Center Site Survey, being conducted by NRC for Congress as required by the Energy Reorganization Act of 1974, is to identify nationwide potential sites and to assess the feasibility of locating power reactors and fuel cycle facilities on such sites. The safeguards aspect is being studied also. Questions to be answered in the report to Congress are given. (DLC)

23847 SOME COMMENTS ON RECENT REGULATORY ACTIONS AFFECTING SAFEGUARDS. Lumb, R. F. (NUSAC, Inc., Falls Church, VA). Nucl. Mater. Manage.; 4: No. 3, 71-74(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

It is stated that the regulators have overreacted to public pressure and imposed too severe material control requirements on the nuclear industry. The NRC decision to postpone Pu recycling for 3 years is protested. (DLC)

23848 RECENT DEVELOPMENTS IN GOVERNMENT POLICY TOWARD TRANSPORTATION OF NUCLEAR MATERIALS. Brobst, W. A. (Energy Research and Development Administration, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 202-209 (Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

In December 1974, AEC announced that it was planning to take over all shipments of Government-owned special nuclear material above trigger quantities. This paper discusses the significance of the nuclear industry of this and other cargo security decisions. The current situation regarding the refusal of the railroads to haul spent fuel except in special train service is reviewed. ERDA has approached the ICC for resolution of the problem and nuclear industry is gathering support. Many states are still attempting to enact local regulations on nuclear shipments, in spite of the preemptive clauses in several Federal acts. The growing problems of viability of the nuclear fuel cycle are reviewed with an eye toward transportation. (auth)

23849 ISSUES RELATED TO CHOOSING A GUARD FORCE STRUCTURE. Auerback, C.; Cusack, J.; Green, L.; Higinbotham, W.; Indusi, J.; Marcuse, W.; Weinstock, E. (Brookhaven National Lab., Upton, NY). Nucl. Mater. Manage.; 4: No. 3, 210-218(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The establishment of a federal security force has been suggested as an additional step to protect nuclear material. The force would be given the responsibility for guarding nuclear facilities and shipments of nuclear materials. This paper summarizes a study to identify the issues that are relevant to choosing between the private guard forces that are presently employed by industry or a guard force under federal authority. To examine the issues which would be relevant, three possible types of security force structures were selected for comparison: a federal force under central authority, a private guard force employed by or under contract to a facility, and a private arrangement to employ local police officers similar to the arrangement for armed guards at airports. The issues were divided into seven categories: (1) Legal Considerations, (2) Liability, (3) Staffing and Operations, (4) Costs, (5) Relationship to Offsite Forces, (6) Management and Control, (7) Transportation. (auth)

23850 INTERNATIONAL SHIPMENTS OF STRATEGIC SPECIAL NUCLEAR MATERIALS. Teer, B. R.; Mangusi, J. (Transnuclear, Inc., White Plains, NY). Nucl. Mater. Manage.; 4: No. 3, 219-224(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The purpose of this paper is to relate some of Transnuclear's experiences in attempting to satisfy the NRC regulations, describe the instances where difficulties were encountered in satisfying these regulations, and suggest some areas where the regulations should be modified. It would appear that a more thorough evaluation of some of the operational restrictions associated with international transport could have alleviated some of the problems now being faced. One of the regulations (73.35(b)) requires that shipments be preplanned to avoid storage times in excess of 24 hours. The preplanning aspect versus the reality of any given transfer which could be affected by all of the uncertainties of air transfer will be discussed in some detail including the "alleged violations" involving such transfers which may be imposed even when assignable to Force Majeure. (auth)

23851 EFFECTIVE GUARD FORCE. Becker, R. C. (Univ. of California, Livermore). Nucl. Mater. Manage.; 4: No. 3, 226-232(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Although the number of guards required to provide adequate physical security of nuclear materials is often the subject of debate, there are more critical factors pertaining to the effectiveness and efficiency of the protective force. The quality of instruction and training, the utilization of modern technology and equipment, the careful analysis of guard functions, the preemployment screening and selection, as well as the competitive pay schedules are the basic questions that should be investigated thoroughly and satisfactorily resolved by the manager. Many studies reveal that a large percentage of the overall cost of a safeguard program is related to the salary of the protective force. This paper presents a method whereby this costly, yet important, commodity in the safeguards arena can be most beneficial. (auth)

23852 SIMULATING PHYSICAL PROTECTION AGAINST OVERT ATTACKS AT FACILITIES USING, PROCESSING, OR STORING NUCLEAR MATERIALS. Marcuse, W.; Indusi, J. P. (Brookhaven National Lab., Upton, NY). Nucl. Mater. Manage.; 4: No. 3, 233-245(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A simulation model has been formulated and is running on the BNL computer which is undergoing refinement and development. It thus far has shown promising results and should prove useful as a tool in evaluating and comparing various physical protection plans under a variety of attacker configurations. In addition it allows one to assess system effectiveness using tradeoffs of guards, perimeter barriers, alarms, procedures and other components in a total security system. Useful data concerning the delay times introduced by various types of barriers and containment devices have been obtained from a few sources. Collection of data along these lines is continuing and may ultimately lead to a need for direct experimentation to complete our data needs. Data from the physical security plans of contractor and licensee facilities may easily be inputted to the model. Testing of these plans against a set of reference attacks via the model may provide useful information relevant to the needs of safeguards and material protection. (auth)

23853 HAND-HELD PERSONNEL AND VEHICLE MONITOR. Kunz, W. E.; Henry, C. N.; Worth, G. M.; Hastings, R. D. (Los Alamos Scientific Lab., NM). Nucl. Mater. Manage.; 4: No. 3, 246-255(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The prototype hand-held monitor can detect small amounts of SNM with much higher probability than the conventional hand-held monitor with audible monitoring of the individual counts. It is also easier to use in field operations because the operator does not need to devote strict attention to small count rate variations in a generally noisy and distracting environment. (auth)

23854 PHYSICAL PROTECTION, ACCOUNTABILITY, AND PROCESS MODELLING. Sanders, K. E. (Nuclear Regulatory Commission, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 256-266(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Process modelling is currently being used in several safeguards related projects for systematically analyzing problems and evaluating solutions. Although this paper primarily discusses the applications of process modelling to automation of nuclear fuel manufacturing processes, other projects are identified. Properly designed automated processing, including handling and storage, should contribute to improved physical protection of special nuclear material and vital equipment as well as to improved special nuclear material control and accountability. A systematic means of determining the "best" overall design for safeguards and evaluating that design must be applied before plant designs are literally set in concrete, necessitating ex post facto design or retrofitting. (auth)

23855 USE OF FAULT AND DECISION TREE ANALYSES TO PROTECT AGAINST INDUSTRIAL SABOTAGE. Fullwood, R. R.; Erdmann, R. C. (Science Applications, Inc., Palo Alto, CA). Nucl. Mater. Manage.; 4: No. 3, 267-276(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Fault tree and decision tree analyses provide systematic bases for evaluation of safety systems and procedures. Heuristically, this paper shows applications of these methods for industrial sabotage analysis at a reprocessing plant. Fault trees are constructed by "leak path" analysis for completeness through path inventory. The escape fault tree is readily developed by this method and using the reciprocal character of the trees, the attack fault tree is constructed. After construction, the events on the fault tree are corrected for their nonreciprocal character. The fault trees are algebraically solved and the protection that is afforded is ranked by the number of barriers that must be penetrated. No attempt is made to assess the barrier penetration probabilities or penetration time duration. Event trees are useful for dynamic plant protection analysis through their time-sequencing character. To illustrate their usefulness, a simple attack scenario is devised and event-tree analyzed. Two saboteur success paths and 21 failure paths are found. This example clearly shows the event tree usefulness for concisely presenting the time sequencing of key decision points. However, event trees have the disadvantage of being scenario dependent, therefore requiring a separate event tree for each scenario. (auth)

23856 AUTOMATED PERSONAL IDENTIFICATION: A NEW TECHNIQUE FOR CONTROLLING ACCESS TO NUCLEAR MATERIALS AND FACILITIES. Eccles, D. R. (Calspan Technology Products, Inc., Buffalo). Nucl. Mater. Manage.; 4: No. 3, 277-284(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Special nuclear materials must be protected against the threat of diversion or theft, and nuclear facilities against the threat of industrial sabotage. Implicit in this protection is the means of controlling access to protected areas, material access areas, and vital areas. With the advent of automated personal identification technology, the processes of access control can be automated to yield both higher security and reduced costs. This paper first surveys the conventional methods of access control; next, automated personal identification concepts are presented and various systems approaches are highlighted; finally, Calspan's FINGERSCAN /sub TM/ system for identity verification is described. (auth)

23857 NEW SCOPE AND GOALS FOR N15 SUBCOMMITTEE INMM-9 (NONDESTRUCTIVE ASSAY). Bishop, D. M. (General Electric Co., San Jose, CA). Nucl. Mater. Manage.; 4: No. 3, 285-298(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The current status of ANSI INMM N15 Standards Committee work in the area of nondestructive assay methods for nuclear materials control is summarized. Related ANSI standards development bases and procedures are described. New and expanded scope and goals for N15 Subcommittee INMM-9 (Nondestructive Assay) are presented, including the formulation of five new task forces to develop standards for the use of nondestructive assay methods for nuclear materials control. (auth)

23858 SOME THINGS WE SHOULD HAVE KNOWN ABOUT CALCULATING LEMUF: BUT DIDN'T. Ferris, Y. M. (Dow Chemical U.S.A., Golden, CO); Geoffrey, J. R.; Suda, S. C. Nucl. Mater. Manage.; 4: No. 3, 337-346(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

After introduction of the concept of limit of error for the MUF (LEMUF), the definition of the quantity, MUF, becomes crucial to the computational method of arriving at its limit of error. In order to demonstrate the MUF-LEMUF conflict a simulation, using a hypothetical manufacturing plant, was designed for the purpose of examining the underlying issues associated with MUF. This simulation takes in the full range of plant activity from receipt of raw materials to shipment of final product. To provide insight into the creating of MUF in real-life situations, the measurements performed at each stage of the manufacturing process are simulated with provisions for taking into account normal measurement variation and abnormal errors or human mistakes in transcription. Also taken into account are materials dispersed in the manufacturing process. At the conclusion of a production period, an accounting process takes place to determine book and physical differences, providing a simulation of MUF. Several suggestions are offered to resolve the current MUF-LEMUF dilemma. It is believed LEMUF can be a viable nuclear materials control technique only if the current dilemma is resolved. (DLC)

23859 RETIMAC: A REAL-TIME MATERIAL CONTROL CONCEPT FOR STRATEGIC SPECIAL NUCLEAR MATERIAL. Shea, T. E. (Nuclear Regulatory Commission, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 376-385(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

As one possible means to upgrade licensee safeguards systems, the NRC is exploring a real-time material control concept. The concept incorporates process controls, material containment provisions, and extensive instrumentation. Plants incorporating this concept would be better able to prevent, deter, and detect diversion, and to assure that diversion has not gone undetected. A substantial methods development, evaluation, and preliminary standards development program is under way to develop the basis for future policy decisions. (auth)

23860 ASSESSMENT OF ACCOUNTABILITY AND SAFEGUARDS EFFICIENCIES. McCormick, N. J.; Erdmann, R. C. (Science Applications, Inc., Palo Alto, CA). Nucl. Mater. Manage.; 4: No. 3, 399-405(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Accountability and safeguards problems fall into the class of problems of searches for an anomaly, which in this case happens to be either an undesired amount of special nuclear material (SNM) in a specimen or the person or parcel which possesses SNM which is being removed surreptitiously. In such searches, principles from information theory can be used to relate the relative efficiency of the search itself to the relative efficiency of the detector. Such correlations are examined and provide some insight into the improvement of the search potentially available from an altered detector efficiency. Example calculations are presented. (auth)

23861 DECISION STRUCTURE FOR PLANT SAFEGUARDS. Schleter, J. C. (National Bureau of Standards, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 406-430(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A systematic study has been performed to determine the information necessary for meaningful safeguards decisions. The resulting Safeguards Information System (SIS) emcompasses all decision makers, in general terms, from those at ERDA Headquarters to the operator on the process line. Only decision makers within the plant are considered in this paper. The basic premises and steps employed in developing SIS are described. These include rapid two-level reporting of abnormal situations, identification of the safeguards decision makers, deduction of safeguards information generated and abnormal situations observed by each as a result of operational tasks, and to whom the information is transmitted. The content of information flowing to and from each decision maker from all sources is established and assurance is given that each decision maker receives the necessary information and that extraneous information is held to a minimum. By means of the analysis, a decision structure for safeguards becomes apparent, the decision capability of each decision maker can be specified, and the sources and flows of information necessary for meaningful safeguards decisions can be identified. The application of the general SIS, to serve as the basis of a plant-specific SIS, is also considered. (auth)

23862 INNOVATIVE AUDIT PROGRAM FOR TODAY'S SAFEGUARDS. Lillpop, J. W. Jr. (General Electric Co., Pleasanton, CA). Nucl. Mater. Manage.; 4: No. 3, 431-440(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

An internal safeguards audit program was developed and implemented at GE facilities to meet the need for effective audit and accurate, timely reporting to management. The concepts from which the program was evolved are summarized. The documentation and reporting mechanism has worked well for both the auditee and management. (DLC)

23863 PIVOTAL SAFEGUARDS ISSUES VIEWED BY NRC. Larson, H. J. (Nuclear Regulatory Commission, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 441-450(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The safeguards responsibilities of the NRC are discussed. Proposed requirements for protection of nuclear material in transit are described. Major safeguards issues, which include Pu recycle, are also discussed. (DLC)

23864 SAFEGUARDS IN REPROCESSING. Ayers, A. L. (Allied-General Nuclear Services, Barnwell, SC). Nucl. Mater. Manage.; 4: No. 3, 451-463(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The recent concern of the Federal Regulatory Agencies toward combating terrorist attack or sabotage has materially increased requirements for nuclear materials safeguards in fuel reprocessing facilities. These requirements have drastically affected both physical protection and materials control and accounting. Some of the changes reduce operating efficiencies with questionable improvement in safeguards and others require clarification before they can be realistically applied. The areas of concern are inventory frequency, materials control and accounting for low enriched uranium, visual monitoring in laboratories, employee search, double barriers during construction, and assay of fission product-contaminated solid waste. (auth)

23865 REAL-TIME ACCOUNTANCY AND CONTROL SYSTEM AT PLUTONIUM FUEL FACILITY OF PNC. Akutsu, H.; Shiga, K.; Tsutsumi, M.; Aoki, M. (Power Reactor and Nuclear Fuel Development Corp., Ibaraki-ken, Japan). Nucl. Mater. Manage.; 4: No. 3, 470-479(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

For mass criticality control, accurate material accountancy and control must be kept in facility where significant amounts of fissile materials are processed. The computerized accountancy and control system was applied into the plutonium facility of PNC and has been improved according to the accumulation of fabrication experience. This system is being operated on real-time basis and also is very useful for the safeguards requirements. The source data for MUF analysis activities are obtained by processing the PIT data. The requirements, structures, and operational method of this system are described in this paper. (auth)

23866 MOUND LABORATORY CONTAMINATED WASTE INVENTORY SYSTEM. Tomes, S. A.; Bishop, T. C. (Monsanto Research Corp., Miamisburg, OH). Nucl. Mater. Manage.; 4: No. 3, 522-534(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

With the advent of tighter security on all nuclear material — both on site and during site-to-site transporting — a unit control system was devised for Mound Laboratory's nuclear waste material. This system provides a unit identification technique for all SS material waste containers. The data capture system will provide intermediate, periodic data reports, control to minimize nuclear material diversion, a standard shipment manifest to national storage sites, and 20-year retrievable life of all data for an audit trail of all inventoried containers. (auth)

23867 IAEA SAFEGUARDS AND THE U. S. Mahy, J. F. Jr. (Energy Research and Development Administration, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 535-541(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

Two major areas are covered: First, the current status of the Presidential Offer in support of the NPT to permit the IAEA to apply its safeguards to any U. S. nuclear activities, exclusive of those activities with direct national security significance. This includes an estimate of when the Offer might come into effect, some of the political issues which will affect its implementation, some of the procedures which have been worked out, and guidelines used in arriving at the current draft of the U. S.-IAEA safeguards agreement. The second area is a review of U. S. activities supporting technically effective IAEA safeguards. This includes a description of current U. S. R and D on techniques and instrumentation, system studies, special exercises, staffing support, and participation in special technical meetings. (auth)

23868 OUTLINE OF A COMPUTERIZED NUCLEAR MATERIAL ACCOUNTING SYSTEM APPLICABLE TO NUCLEAR POWER REACTORS. Handshuh, J. W. Nucl. Mater. Manage.; 4: No. 3, 557-566(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A computerized nuclear material accounting system is described which enables a utility to account for its material throughout the entire fuel cycle. From input of transactions, the system records and reports inventories and transactions by accounts which the user may establish for discrete locations, item control areas, further subdivisions, and material types. Account numbers are designed so that accounts and records are automatically sorted in the order desired. The system also generates the Material Status Reports for the Nuclear Regulatory Commission. (auth)

23869 SOCIETAL RISK APPROACH TO SAFEGUARDS DESIGN AND EVALUATION. Murphey, W. M. (National Bureau of Standards, Washington, DC); Sherr, T. S.; Bennett, C. A. Nucl. Mater. Manage.; 4: No. 3, 588-606(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

A comprehensive rationale for safeguards design and evaluation, and a framework for continuing systematic assessment of the system's effectiveness and efficient allocation of available safeguards resources for balanced protection, were developed. The societal risk approach employed considers the likelihood of successful destructive acts involving nuclear materials or facilities and the magnitude of the effects on society. The safeguards problem is described in terms of events affecting societal risk and adversary actions. Structure of the safeguards system and the evaluation of its adequacy are discussed. Adversary characteristics are also discussed. (DLC)

23870 MASS MEDIA DIFFERENCES IN "NUCLEAR NEWS" REPORTING: IMPLICATIONS FOR PUBLIC OPINIONS AND ACCEPTABLE SAFEGUARDS. Williams, A. (Kansas State Univ., Manhattan); Williams, J. Nucl. Mater. Manage.; 4: No. 3, 607-616(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The technical and political issues of diversion safeguards are at best confusing to the general public, who derive most of their information about nuclear science from the mass media. This investigation compared "nuclear news" of all kinds in three national mass media for thirty-three months of 1972-1974 to examine the quantity and quality of atom-related news they provide. Findings from The New York Times, U. S. News and World Report, and the ABC, CBS, and NBC evening news indicate grounds for low public familiarity with essential concepts of safeguards, and consequently, for consumer value conflicts and weak popular supports for safeguards-related policy. (auth)

23871 SAFEGUARDS, THE PRESS, AND THE PUBLIC. Nucl. Mater. Manage.; 4: No. 3, 617-632(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

This is a panel discussion between representatives of government laboratories and agencies, the press, IAEA, and industry. (DLC)

23872 NUCLEAR REGULATORY RESEARCH: PROGRAM IN REVIEW. Kouts, H. J. C. (Nuclear Regulatory Commission, Washington, DC). Nucl. Mater. Manage.; 4: No. 3, 50-56(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The research program of the US NRC is reviewed. Safeguards and measures are defined. Accounting and MUF are also covered. Questions on fuel cycle, inspection, and NRC's information system are outlined. A few areas of research in physical protection that appear attractive are listed. (DLC)

Disposal and Storage

Refer also to abstracts 22830, 22831, 22834, and 23881.

23873 (BNWL-1944) RADIATION EFFECTS IN SOLIDIFIED HIGH-LEVEL WASTE. Part I. Stored Energy. Roberts, F. P.; Jenks, G. H.; Bopp, C. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 91p. Dep. NTIS $6.00.

Buildup and release behavior of radiation-induced stored energy was investigated for several synthetic solidified high-level waste forms: two borosilicate glass formulations, calcine, calcine on Al_2O_3, and a hot press compact of 50 percent waste oxide-50 percent quartz. Fused silica and Al_2O_3, without waste oxides, were also investigated. Average heat capacities of some of the materials were also measured. The materials were irradiated either by internal alpha radiation ^{244}Cm or by neutron irradiation in ORR. The irradiations simulated the effects resulting from self-irradiation of the waste for storage periods up to nearly 1000 years for wastes from PWR-UO_2 fuel [equivalent to periods of approximately 10 years for mixed wastes from UO_2 fuel ($^3/_4$) and plutonium recycle fuel ($^1/_4$)]. Results showed that the amounts of stored energy over a period of about 10 years at relatively low storage temperatures following reprocessing are such that only moderate temperature increases (less than 200°C) in the wastes would occur in the event of sudden release of the stored energy. Extrapolation to longer storage times in a geologic repository indicated that saturation of energy storage would occur at 50 cal/g or less for each of the waste types; the DELTA T corresponding to release of 50 cal/g would be about 250° for most of the waste types. The experimental results also showed no apparent way in which a sudden release could occur except as a result of sudden large increases in waste temperature caused by a heat source other than the stored energy. The sudden but transient increases in waste temperatures of up to 200°C following low temperature storage or of up to 250° during long term repository storage should have no serious adverse effects on the waste container or on the physical and chemical properties of the wastes. The maximum linear expansion of wastes which would result from a DELTA T of 250°C would be about 0.1 percent, and the steel walls of the waste canister would easily accommodate the stress from this expansion. 36 references 23 tables, 23 figures. (DLC)

23874 (BNWL-SA-5497) PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS: RADIOLOGICAL CONSIDERATIONS. Unruh, C. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 44p. (CONF-751101-67). Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A comprehensive analysis of potential radiological impact needs to be developed in nuclear power reactor impact statements. The analysis should examine the pathways that may result in radioactive material from effluents and waste streams interacting with man and biota. Each facility location and proposed mode of operation needs independent study to establish the principal and significant pathways of radiation exposure. (auth)

23875 (PB-241065) ENVIRONMENTAL SURVEY OF TRANSPORTATION OF RADIOACTIVE MATERIALS TO AND FROM NUCLEAR POWER PLANTS. Supplement I. Environmental Survey. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Apr 1975. 16p. (NUREG-75/038). NTIS $3.25.

Supplement No. 1 to WASH-1238.

Supplement I to WASH-1238, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," has been prepared by the Office of Standards Development, U.S. Nuclear Regulatory Commission. This supplement presents data and identifies methods used to derive the environmental impact and risk values in Summary Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." Summary Table S-4 is referred to and set out following section 51.20(g) of the Commission's regulation, "Licensing and Regulatory Policy and Procedures for Environmental Protection," 10 CFR Part 51. (GRA)

23876 (PB-241184) NATIONAL CENTER FOR RADIOLOGICAL HEALTH RESEARCH PROJECTS SUPPORTED BY GRANT FUNDS, JUNE 30, 1968. Sabo, J. J.; Leopold, S. (National Center for Radiological Health, Rockville, Md. (USA)). 30 Jun 1968. 306p. NTIS $9.25.

Contents: Methodology of exposure reduction for dental and medical practices; Development of dosimetry, instrumentation and systems; Studies of nuclear plant monitoring, surveillance and design characteristics; Studies of protective action in environmental contamination; Human epidemiology studies and population exposure; Radiation bio-effects; Mechanisms of radiation damage and effects modification; Studies in basic radiation physics and chemistry; Studies of non-ionizing radiation; Beneficial applications of radiation. (GRA)

23877 (PB-241228) SUMMARIES OF THE RESEARCH SUPPORTED WITH PROJECT GRANT FUNDS BY DIVISION OF RADIOLOGICAL HEALTH. Hahn, P. F. (Public Health Service, Washington, D. C. (USA). Div. of Radiological Health). 4 Jan 1965. 193p. NTIS $7.00.

Contents: Program areas supported by the Division of Radiological Health in its extramural research grants program; Effects of radiation on man and matter; Measurement of radiation exposure; Development of methodology for exposure reduction and control; Numerical index; Investigator index; KWIC (Keywork-in-Context) index; Geographical distribution of current active research grants. (GRA)

23878 (PB-241229) SUMMARIES OF THE RESEARCH SUPPORTED WITH PROJECT GRANT FUNDS BY THE DIVISION OF RADIOLOGICAL HEALTH, SUPPLEMENT NO. 1. Hahn, P. F. (Public Health Service, Washington, D. C. (USA). Div. of Radiological Health). Jul 1965. 81p. NTIS $4.75.

Contents: Program areas supported by the division of Radiological Health in its extramural research grants program; Effects of radiation on man and matter; Measurement of radiation exposure; Development of methodology for exposure reduction and control; Numerical index; Investigator index. (GRA)

23879 (PB-241300) A SURVEY OF THE FARALLON ISLANDS RADIOACTIVE WASTE DISPOSAL SITE. Summary Report. (Interstate Electronics Corp., Anaheim, Calif. (USA). Environmental Engineering Div.). Feb 1975. Contract EPA-68-01-0796. 23p. (IEC-446-OC-1649). NTIS $3.25.

The report is a summary of the August 1974 survey of a waste disposal site near the Farallon Islands that had been used between 1946 and 1966 for the disposal of radioactive waste materials. This survey was the first in which a deepwater (850) meter radioactive waste disposal site had been successfully relocated and subjected to a comprehensive survey. The U.S. Navy's CURV III, an unmanned remote controlled submersible, was used to investigate the condition of the containers. The report contains site location chart and high quality benthic color plates showing the condition of the containers. (GRA)

23880 (USGS-4339-5) SHALE, MUDSTONE, AND CLAYSTONE AS POTENTIAL HOST ROCKS FOR UNDERGROUND EMPLACEMENT OF WASTE. Merewether, E. A.; Sharps, J. A.; Gill, J. R.; Cooley, M. E. (Geological Survey, Denver, Colo. (USA)). 1973. Contract AT(40-1)-4339. 90p. Dep. NTIS $5.00.

The suitability of the argillaceous formations in the conterminous United States as host rocks for underground waste emplacement is reviewed in terms of available geologic information. The strata are considered mainly according to their dimensions, depth, composition, permeability, structural and seismic history, and to the extent of drilling in the area. Shale, mudstone, and claystone of marine origin, in areas of little structural deformation and seismic risk, are generally the most promising. These include the Ohio Shale of Devonian age in northern Ohio and the Devonian-Mississippian Ellsworth Shale and Mississippian Coldwater Shale in Michigan. In the Rocky Mountain states, the Pierre Shale and other thick shales of Late Cretaceous age are also potential host rocks. (auth)

Handling Equipment and Procedures

23881 (UCRL-5007-75-1, pp 39-40) DECONTAMINATION: DECONTAMINATION OF GLOVED BOXES BY ACID WASH. 15 Aug 1975.

In hazards control progress report No. 50, January–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

A decontamination procedure for gloved boxes is described. (GHT)

23882 HIGH-TEMPERATURE GAS-COOLED REACTOR SPENT AND RECYCLE FUEL SHIPPING. Reeser, H. G. (General Atomic Co., San Diego, CA). Proc. Am. Power Conf.; 37: 194-204(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

A description is given of two shipping systems, one using a truck and the other a railroad car, for spent and refabricated High-Temperature Gas-cooled Reactor (HTGR) fuel. The materials and design for the various shipping casks are discussed, and the safety features and regulation conformance of both shipping systems are presented. (PMA)

23883 RADIOACTIVE WASTE: PLANT TO DISPOSAL. Greco, J.; Ingwersen, J. L. (Tennessee Valley Authority, Chattanooga). Proc. Am. Power Conf.; 37: 205-212(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The design and operation of the radioactive waste-handling system for the Browns Ferry Nuclear Plant are presented. Studies were made of casks and support equipment and services, including trailers, tractors, disposal ground services, liners, liner filters, and liner level instrumentation. The advantages of a utility-owned cask and of casks from a contracted service are weighed, and it was determined that only frequent shipments of spent condensate cleanup resin would make a TVA-owned cask economically feasible. (PMA)

Transportation

Refer also to abstracts 23848, 23882, and 23883.

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 23067.

23884 (CEA-N-1812) MONOENERGETIC NEUTRON PRODUCTION BELOW 20 MeV WITH VAN DE GRAAFF ACCELERATORS. Soleilhac, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). Jul 1975. 21p. (In French). Dep. NTIS (US Sales Only) $3.50.

The main parameters influencing the production of intense monoenergetic neutron sources below 20 MeV with Van de Graaff accelerators are analyzed, i.e., choice of the reaction, secondary reactions, neutron production cross sections, neutron energy spread. The neutron yields for a given neutron energy spread are deduced for the useful reactions employed with solid or gaseous targets. (auth)

23885 (CONF-741040-P2) PROCEEDINGS OF THE THIRD CONFERENCE ON APPLICATION OF SMALL ACCELERATORS, Denton, Texas, October 21-23, 1974. Volume II. Industrial Applications of Small Accelerator. Duggan, J. L.; Morgan, I. L. (eds.). (North Texas State Univ., Denton (USA)). 1974. 392p. Dep. NTIS $10.60.

This conference is the third symposium on the Application of Small Accelerators. The two previous conferences were concerned mainly with research and teaching applications of accelerators. This 1974 conference was composed of two symposia which ran in parallel. The first symposium was mainly directed towards research and teaching applications of accelerators. The papers from this symposium were published as Volume I, "The Use of Small Accelerators in Research and Teaching." The second symposium covered the "Industrial Applications of Small Accelerators" and Volume II of the 1974 proceedings has that title. Twenty-seven papers were abstracted for ERDA Energy Research Abstracts (ERA), and 23 for Nuclear Science Abstracts (NSA). (SFL)

For abstracts of individual papers see: 22701–22705, 22727, 23067, 23068, 23302, 23374, 23409, 23714, 23728, 23801, 23839, 23886–23890, 24991, 25006, and 25007.

23886 (CONF-741040-P2, pp 86-101) ELECTRON CURING OF SURFACE COATINGS. Nablo, S. V. (Energy Sciences Inc., Bedford, MA). 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

The technical development of electron curing of surface coatings has received great impetus since 1970 from dramatic changes in the economics of the conventional thermal process. The most important of these changes are reviewed, including: the Clear Air Act, increasing cost and restrictive allocation of energy, decreased availability and increased costs of solvents, competitive pressure for higher line productivity. The principles of free-radical initiated curing as they pertain to industrial coatings are reviewed. Although such electron initiated processes have been under active development for at least two decades, high volume production applications on an industrial scale have only recently appeared. These installations are surveyed with emphasis on the developments in machinery and coatings which have made this possible. The most significant economic advantages of electron curing are presented. In particular, the ability of electron curing to eliminate substrate damage and to eliminate the curing station (oven) as the pacing element for most industrial surface coating curing applications is discussed. Examples of several new processes of particular interest in the textile industry are reviewed, including the curing of transfer cast urethane films, flock adhesives, and graftable surface finishes.

23887 (CONF-741040-P2, pp 310-316) ACCELERATOR CHARACTERISTICS AS APPLIED TO RADIATION THERAPY. Oliver, G. D.; Purdy, J. A. (Washington Univ., St. Louis). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

Electron accelerators have been used in the treatment of human cancers since 1953. Betatrons, which produce high energy x-rays, have been preferred for specific regimens for treatment of, for example, carcinoma of the cervix, prostate, and lung. Linear accelerators, introduced to radiation therapy in the late 1960's, have only recently become competitive with the betatrons. However, at present neither machine type can provide all the desirable features of a medical electron accelerator. Comparisons are presented relating the features of photon and electron beams, such as energy, depth dose, surface dose, leakage, associated neutron dose, output, and collimation. Other comparisons consider machine upkeep and duty-cycle.

23888 (CONF-741040-P2, pp 317-323) DT NEUTRON SOURCES FOR CANCER THERAPY. Kelsey, C. A. (Univ. of Wisconsin, Madison). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

At the present time there are two approaches to providing fast neutrons for cancer therapy. One uses cyclotrons and the beryllium DN reaction, the other uses the DT reaction. Most current clinical studies are being conducted using cyclotron produced neutrons. The major disadvantages of the DT reaction at the present time are the short target lifetime and low output of DT sources, a result of the intense heating of the target by the beam. The problems associated with DT target development and the current status several approaches to high intensity DT sources are discussed. Topics include: (1) tritium targets; (2) metal hydride targets; (3) sealed tubes; (4) solid metal targets; (5) ice targets; (6) rotating targets; and (7) gas targets. (PMA)

23889 (CONF-741040-P2, pp 334-343) RACETRACK MICROTRON: ITS POTENTIAL IN RADIATION THERAPY. MacDonald, J. C. F. (Ontario Cancer Foundation London Clinic); Froelich, H. R. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

A discussion of the desirable characteristics of an electron accelerator for radiotherapy is given, based on personal interviews with a number of radiotherapists and radiological physicists in the United States. It is quite possible that the racetrack microtron, in its fully-developed form, will meet these requirements at a price that is not beyond the financial capabilities of a medium-sized treatment center. The principle of operation is given, and some existing facilities are discussed, including the experimental 6 orbit, 18 MeV racetrack microtron at the University of Western Ontario. This proof of principle unit is complete and operating, and work is proceeding on the construction of a 25 MeV microtron accelerator to be used in an isocentric therapy unit. (PMA)

23890 (CONF-741040-P2, pp 344-355) MEDICAL LINAC DESIGN POSSIBILITIES. Knapp, E. A.; Bradbury, J. N. (Los Alamos Scientific Lab., NM). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

During the last five years, a dramatic expansion of the use of accelerator generated radiations in medicine became possible. The application of resonant standing wave accelerator technology to conventional medical linac systems brought them within the reach of hundreds of cancer treatment centers throughout the country. In addition, the construction of meson factories will allow the use of secondary particle beams for cancer therapy. A brief discussion of the LAMPF linear accelerator is provided, including the properties of the side coupled accelerator system. Some design criteria for possible dedicated meson producing accelerator systems for hospital use are described.

23891 FIELD MEASUREMENTS OF A 5 MeV BETATRON. Saboo, H. K.; Misra, S. C.; Gupta, U. C. (Bhabha Atomic Research Center, Bombay). pp 269-272 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

A description is given of the measurements of the field index, the position of the equilibrium orbit, and the azimuthal variation of the phase of the magnetic field of a 5 MeV betatron. A set of concentric coils of different radii located in the median plane of the magnet was used for measurement of the field index and the position of the equilibrium orbit. The induced voltages in these coils were measured by a null method at different times in the

acceleration cycle. The electric field at any radius was calculated from the induced voltage. The time variation of the radius of the equilibrium orbit was obtained from the minimum of the electric field vs radius curve. The average value of the magnetic field as a function of radius was calculated from the induced voltage in the coils. The slope of the magnetic field vs radius curve on a log-log scale gave the value of the average field index. For measurements of the phase of the magnetic field on the equilibrium circle, two peaking strips of permalloy were used. One was fixed at some azimuth, while the other was placed at different azimuths. The phase difference was measured as the time difference between the peak of the pulses from the two strips. Initially, a variation of ±20 μsec was observed, which was reduced to ±1.2 μsec by proper orientation of the magnet poles and shimming.

23892 SOLUTE–SOLUTE TRANSFER IN SOLUTION EXCITED WITH NANOSECOND PULSES OF 3 MeV ELECTRONS. Horrocks, D. L. (Beckman Instruments, Inc., Irvine, Calif., U. S. A.). Nucl. Instrum. Methods; 128: No. 3, 573-574(15 Oct 1975).

The energy transfer between PPO and M_2-POPOP in toluene solutions was measured using the nanosecond pulses of 3 MeV electrons from a pulsed Van de Graaff accelerator. The energy transfer rate constant obtained in this experiment, using the Stern–Volmer relationship, was 2.45×10^{13} l/mol s. (NL)

23893 THE NINA POLARISED PHOTON BEAM. Jackson, A. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Instrum. Methods; 129: No. 1, 73-83(1 Nov 1975).

A beam of polarized photons is used at the SRC Daresbury Laboratory for the study of high energy photoproduction processes. The photons are produced by the bremsstrahlung interaction between the high energy electrons, accelerated in the 5 GeV synchrotron, NINA and an accurately oriented, nearly perfect diamond crystal target. A description is given of the target mechanism, the selection of suitable diamond crystals and the commissioning of the NINA polarized photon beam. (NL)

23894 ELIT TYPE PULSE ELECTRON ACCELERATORS BASED ON A TESLA TRANSFORMER. Vasserman, S. E. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 44-50 of Technical Developments and Prospects of Sterilization by Ionizing Radiation. Montreal; Multiscience Publications (1974).

From conference on technical developments and prospects of sterilization by ionizing radiation; Vienna, Austria (1 Apr 1974).

Three modifications of ELIT type accelerator are reviewed. These accelerators are designed for various industrial purposes, including sterilization of medical instruments. (Electr. Electron. Abstr.)

23895 DEVELOPMENTS IN TRANSFORMER ACCELERATORS AND THE TECHNOLOGY OF PULSED ELECTRON STERILIZATION AT ULTRA-HIGH DOSE RATES. Noblo, S. V. (Energy Science Inc., Burlington, MA). pp 51-70 of Technical Developments and Prospects of Sterilization by Ionizing Radiation. Montreal; Multiscience Publications (1974).

From conference on technical developments and prospects of sterilization by ionizing radiation; Vienna, Austria (1 Apr 1974).

The principles of operation of the transformer accelerator are reviewed. The features of the pulse transformers operating in the double resonance mode are presented, and compact designs which take advantage of the high insulation of materials in which the pulsed voltage mode supplied by the transformer are discussed. Other approaches to the generation of medium energy pulsed sources are also referenced, covering the dose rate regime from 10^8 to 10^{14} rads/second. Some comparative lethality and degradation studies conducted over this range, are presented demonstrating the potential advantages of the high sterilization rates offered by this equipment. (Electr. Electron. Abstr.)

23896 ADVANCES IN ELECTRON BEAM LINEAR ACCELERATOR TECHNOLOGY. Haimson, J. (Haimson Research Corp., Burlington, MA). pp 71-106 of Technical Developments and Prospects of Sterilization by Ionizing Radiation. Montreal; Multiscience Publications (1974).

From conference on technical developments and prospects of sterilization by ionizing radiation; Vienna, Austria (1 Apr 1974).

A description is given of how the microwave electron linear accelerator differs fundamentally from the other forms of particle accelerators. A brief review of the early history and development is given. The simplified theory and operational characteristics of linear accelerators are presented; and it is shown that rf to electron beam power conversion efficiencies of 85 to 90% are attainable with microwave accelerating structures. Typical performance figures in the range of 3 to 7 MeV with beam power levels up to 36 kW are listed. Twenty year trend curves and component lifetime data reveal that technological advances have resulted in a dramatic improvement in the reliability of high power linear accelerators. The high voltage accelerating column is a short, all-metal waveguide structure. These structures, together with advanced design, all-brazed, metal and ceramic electron gun assemblies which are highly resistant to radiation damage, are illustrated and discussed in detail. (Electr. Electron Abstr.)

23897 DC ACCELERATORS. Rambler, W. J. (Radiation Polymer Co., Plainfield, IL). pp 115-135 of Technical Developments and Prospects of Sterilization by Ionizing Radiation. Montreal; Multiscience Publications (1974).

From conference on technical developments and prospects of sterilization by ionizing radiation; Vienna, Austria (1 Apr 1974).

A review is given of accelerators which utilize a non-varying (dc) high voltage to achieve the potential drop necessary for particle acceleration. These accelerators can be divided into two distinct energy groups, with the line of division being about 300 keV. Technology developments are discussed, including the new generation of high voltage machines. (Electr. Electron Abstr.)

23898 HIGH-VOLTAGE ELECTRON ACCELERATORS WITH LOCAL BIOLOGICAL SHIELD. Ivanov, A. S. (Scientific Research Inst. of Electrophysical Apparature, Leningrad). pp 107-114 of Technical Developments and Prospects of Sterilization by Ionizing Radiation. Montreal; Multiscience Publications (1974).

From conference on technical developments and prospects of sterilization by ionizing radiation; Vienna, Austria (1 Apr 1974).

Basic parameters and construction of some high-voltage electron accelerators are presented. The accelerators consist of: (1) a high direct-voltage source (transformer with rectifier elements, incorporated between sections of a high-voltage winding); (2) an electron source with a tungsten or lanthanum hexaboride cathode; (3) a frequently-sectional accelerating tube; (4) an electron beam scanning system of electromagnetic type; (5) a vacuum system; and (5) interlock and signal systems. (Electr. Electron Abstr.)

Auxiliaries and Components

Refer also to abstract 23423.

23899 (LA-6006-MS) GENERAL ION-OPTICAL CORRECTION ELEMENT. Ferguson, H. D.; Spencer, J. E.; Halbach, K. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-Eng-36. 12p. Dep. NTIS $4.50.

A general purpose type of multipole magnet is described which provides some unique advantages. It produces a very uniform dipole field which can be rotated about the longitudinal axis of the magnet. Higher order multipoles can also be rotated and can be excited simultaneously without the use of independent coils. A magnet having octupole geometry was built and shown to verify the basic ideas. (auth)

23900 (SAND-75-0464) TECHNIQUES FOR FABRICATING AN INFRARED OPTICAL PYROMETRY SYSTEM FOR PULSED ELECTRON BEAM DIAGNOSTICS. Ouellette, A. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1976. Contract AT(29-1)-789. 25p. Dep. NTIS $4.50.

A description is given of an infrared optical pyrometry system which was designed to make fast time resolved temperature measurements. The purpose of this equipment is to determine the amount of energy from an electron beam or some other type of pulsed energy deposition that is absorbed in a target. The system is capable of measuring energy deposition levels up to 4000 J/g in carbon, which corresponds to a graphite target temperature of 2200°C. Methods of fabrication, alignment, and calibration are presented. The measurement of absorbed energy in a target as a function of position and depth is discussed as a possible application, and several measurements are described which permit a comparison of results from this system with those taken by other methods.

23901 (SAND-75-5494) X-RAY SIMULATION DEVELOPMENT. Posey, L. D.; Tollefsrud, P. B.; Woodall, H. W.; McDaniel, D. H.; Allred, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 25p. (CONF-751094-1). Dep. NTIS $3.50.

From fifth symposium on nuclear survivability of propulsion and ordnance systems; Menlo Park, California, United States of America (USA) (7 Oct 1975).

Design modifications are discussed for an electron beam accelerator used as a Bremsstrahlung x-ray source. The primary goal of the program, to obtain a reliable 5 cal/gm exposure capability, can be accomplished with beam compression by an external magnetic guide field. Initial operating characteristics and performance improvements are presented. (PMA)

23902 CURRENT MONITOR FOR THE MEASUREMENT OF A PULSED ION BEAM. Reimann, R.; Rueede, M. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Nucl. Instrum. Methods; 129: No. 1, 53-58(1 Nov 1975). (In German).

A beam monitor which permits the non-intercepting measurement of a pulsed proton beam and the associated electronics for an analog and digital display is described. With the help of an automatic range selector beam currents from 0.1 to 250 μA can be measured. (NL)

23903 COIL SYSTEM GENERATING A STATIONARY FIELD ALONG ITS AXIS WHICH TURNS UNIFORMLY FROM TRANSVERSAL INTO LONGITUDINAL DIRECTION. Vogt, P. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Nucl. Instrum. Methods; 128: No. 3, 429-433(15 Oct 1975).

A magnetic guide field is described which turns the polarization vector of a beam of polarized thermal neutrons adiabatically from transversal into longitudinal direction or vice versa. It is obtained by vector addition of a transversal field (generated by a large toroidal coil) and a longitudinal field (generated by a cylindrical coil). The strength of the longitudinal field was designed and calculated so that the resultant of the field rotates uniformly. The calculation required the numerical solution of a Fredholm integral equation of the first kind. (NL)

23904 BEAM TRANSPORT SYSTEM FOR A 4 MeV DYNAMITRON ACCELERATOR. Hammer, J. W.; Schuepferling, H. M. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Strahlenphysik); Bergandt, E.; Pflaum, T. (Leybold-Heraeus G.m.b.H. und Co. K. G., Koeln (F. R. Germany)). Nucl. Instrum. Methods; 128: No. 3, 409-424(15 Oct 1975).

A beam transport system was constructed for a 4 MeV Dynamitron accelerator which permits safe and dependable handling on ion beams up to 3 mA or electron beams up to 5mA. In order to meet these high requirements, beam transport components such as slit shutters, apertures, Faraday cups, profile monitors, and quick-closing valves were specially developed and built. As many as possible of the parts of the system were made of stainless steel with metal seals, applying throughout the newest findings in ultrahigh vacuum technology. The entire installation is pumped with an oil-free pumping system. (NL)

Ion Sources and Injection and Extraction Systems

23905 SYSTEM OF PRECISE MEASUREMENT OF ACCELERATOR EXTRACTION EFFICIENCY. Hornstra, F. Jr. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Instrum. Methods; 128: No. 3, 435-440(15 Oct 1975).

The extraction efficiency of the Fermi National Accelerator Laboratory synchrotron is determined by measuring the extraction inefficiency with a simple calibrated loss-measuring system. The relative inefficiency subtracted from unity gives a precise measurement of extraction efficiency from measurements made with only nominal precision. An uncertainty of ±10% in the efficiency measurement allows extraction efficiency of 99% to be known with an uncertainty of ±0.1%. The concept also can be used to intercalibrate accelerator internal and external intensity monitors and to indicate the amount of beam that may be lost elsewhere in a large accelerator. The concept, system and applications are discussed. (NL)

23906 NEW TECHNIQUE FOR THE BUNCHING OF CHARGED PARTICLE BEAMS. Cramer, J. G. (Washington Univ., Seattle (USA). Dept. of Physics). Nucl. Instrum. Methods; 128: No. 3, 597-598(15 Oct 1975).

A new technique is proposed for converting a continuous beam of charged particles into a bunched beam, i.e., a beam which has a pulsed time structure and comes in short bursts. The technique suggested uses previously unrecognized bunching properties of a crossed electric and magnetic field to give the beam the desired time structure. The device does not change the energy or energy resolution of the beam but does degrade the beam emittance. It is thought to be particularly applicable in situations where a conventional gap buncher is unsuitable, such as the bunching of slow ions at high frequencies. (NL)

23907 HOLLOW-BEAM PROTOTYPE OF THE UNIVERSAL NEGATIVE ION SOURCE FOR TANDEM ACCELERATORS. Sherwood, J. E.; Zwicker, R. D. (University of the Witwatersrand, Johannesburg (South Africa). Nuclear Physics Research Unit). Nucl. Instrum. Methods; 129: No. 1, 43-45(1 Nov 1975).

A variation of the sputtering-type ion source for the production of negative ion beams is described, in which a hollow beam geometry is used, and a hot wire ionizer replaces the sintered tungsten button. (NL)

23908 OPTIMIZATION OF SHAPE AND POSITION OF DEFLECTOR FOR A VARIABLE ENERGY CYCLOTRON. Sethi, R. C.; Jain, A.; Bhandari, R. K.; Divatia, A. S. (Bhabha Atomic Research Center, Bombay). pp 278-281 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

For a deflector in a variable energy cyclotron, the turn separation, the septum thickness, and the deflector shape are the major factors which define the extraction efficiency. To study the extraction efficiency, a reference particle is chosen, and its equilibrium properties are calculated by solving ten coupled simultaneous differential equations in a given azimuthally varying magnetic field. Optimum efficiency values are searched under specified constraints, so that the reference particle goes through the deflector channel. An optimum position is chosen so that the maximum number of particles go through. By using the magnetic field data of LBL 88" cyclotron for 29 MeV alphas, the optimum shape and position of the deflector was obtained. An extraction efficiency of 33% is indicated.

Ion Optics and Field Calculations

Refer also to abstract 24271.

23909 (DESY-L-Ueb-206) CALCULATION OF FIELDS EXCITED BY AN ELECTRON BEAM MOVING IN A COAXIAL CAVITY RESONATOR. Mamonov, V. N.; Rubin, S. B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). 1975. 10p. (In German). INIS.

5 figs.; 3 refs. Translated from the Russian report preprint JINR-P-9-8625, Dubna, 1975.

The technique of determining the secondary field generated as an electron bundle moves along the axis of a cylindrical cavity resonator with hollow feed waveguides, in which the secondary field in each subregion of the structure is decomposed into the hollow waveguide eigenharmonics of that region and the field of the source can be represented as the field of a bundle moving in an infinite waveguide of the corresponding given subregion of the radius, is extended also to the case of a coaxial cavity resonator. (DE)

23910 EXPERIENCE WITH DETERMINING SPECTRA OF FAST NEUTRONS NEAR NEUTRON GENERATORS. Hrabovcova, A.; Nikodemova, D.; Minarik, F. Jad. Energ.; 20: No. 1, 19-24 (1974). (In Czech)

The relative deviation minimization method was used for determining the energy spectra of fast neutrons in two neutron generators (14.6 MeV) by means of six or four threshold neutron detectors. The spectra indicate a substantial contribution of energy-degraded neutrons. (auth)

23911 STATIC ELECTRIC FOCUSING IN LOW-ENERGY LINEAR ACCELERATORS. Vlasov, A.D. Sov. Phys.—Tech. Phys. 20: No. 3, 420-421 (Mar 1975).

Static electric focusing in drift-tube linear accelerators is considered, and the possibilities of using such focusing for protons in the energy range from 50-100 keV to a few MeV are evaluated. It is shown that static focusing is only effective for relatively large velocity increments in the accelerating gaps. It is therefore necessary to increase significantly the amplitude of the accelerating field or the wavelength (to 8-24 m). The accelerator then has only a small number of gaps. The associated effect of so-called alternating self-focusing is also considered. (auth)

23912 OPTIMIZATION OF ISOLATED ELECTRON PULSES IN THE PICOSECOND RANGE FROM A LINEAR ACCELERATOR USING A STREAK CAMERA-TV DIAGNOSTIC SYSTEM. Mavrogenes, G.S.; Jonah, C.; Schmidt, K.H.; Gordon, S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439); Tripp, G.R.; Coleman, L.W. Rev. Sci. Instrum. 47: No. 2, 187-189 (Feb 1976).

We describe the technique and the results of a measurement of the width of a fine structure pulse from our L-band electron linear accelerator. The pulse width was measured by measuring the width of the Čerenkov light pulse generated by the electron beam using a streak camera–TV camera–computer system. With very low beam currents, a pulse width of 20 psec (FWHM) was measured, while at higher beam currents a pulse width of 27 psec was measured showing a space-charge effect. In addition, a broad energy spectrum for the electrons or improper focusing into a 270° bending magnet was also shown to increase the pulse width of the beam after it had traversed the magnet. (auth)

Storage Rings

23913 (BNL-50486) ISABELLE AS A MUON STORAGE FACILITY. Humphrey, J. W. (Brookhaven National Lab., Upton, N. Y. (USA)). 12 Jan 1975. Contract E(30-1)-16. 7p. Dep. NTIS $3.50.

The possibility of using ISABELLE as a muon storage ring and as a source of electron neutrinos is discussed. An average intensity of about 10^7 muons per second or 3×10^5 neutrinos per second may be achievable. (auth)

Experimental Facilities

Refer also to abstract 23419.

23914 (AERE-M-2757) DATA ACQUISITION SYSTEM FOR DIFFRACTION EXPERIMENTS ON THE HARWELL LINAC. Johnson, D.A.G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Dec 1975. 19p. Dep. NTIS (US Sales Only) $3.50. UK £ 1.00.

Programs were developed for the on-line accumulation of data from the Total Scattering Spectrometer on the Harwell Linac. Facilities are provided for defining the experimental parameters and controlling the sample-changer. There is also provision for users to examine their data and to perform some preliminary data reduction. The data can be sent to the IBM 370/168 Central computer for further processing.

23915 (JINR-P8-9168) REFRIGERATOR WITH HELIUM-3 SOLUTIONS IN HELIUM-4 FOR OPERATION IN BEAMS OF SLOW NEUTRONS. Alfimenkov, V. P.; Ovchinnikov, O. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 20p. (In Russian). (CONF-751082-1). Dep. NTIS (US Sales Only) $3.50.

From 14th conference on physics and technology of low temperature; Bratislava, Czechoslovakia (20 Oct 1975).

In working with chilled samples in a beam of slow neutrons, it is undesirable to have a cooling fluid in the neutron beam, so that samples must be chilled indirectly. Also the refrigerator must be remote controlled. The principal design features and operating characteristics of a refrigerator meeting these requirements are described. (JSR)

23916 SIMPLE TAPE VACUUM SEAL FOR QUICK SAMPLE REMOVAL FROM HIGH VACUUM. Carter, H. K.; Mlekodaj, R. L. (UNISOR, Oak Ridge, Tenn. (USA)). Nucl. Instrum. Methods; 128: No. 3, 611-613(15 Oct 1975).

A simple vacuum seal has been developed that allows a tape to be pulled from (less than 10^{-6} torr) into atmosphere with only a small change in high-vacuum pressure. (NL)

23917 AUTOMATIC SCANNING EXCITATION FUNCTION. Bhalerao, P. J.; Vaze, M. Y.; Gupta, S. K.; Baba, C. V. K. (Bhabha Atomic Research Center, Bombay). pp 285-287 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

In measuring excitation functions using an accelerator, it is advantageous to record the complete excitation function between two energy limits at the same time. This reduces the effects due to variation of background and nonuniformity of the target thickness. An arrangement was installed at the 5.5 MeV Van-de-Graaff accelerator for this purpose. The reference voltage of the analyzing magnet current supply varies between two given values by a sawtooth voltage. The analyzing magnet current then varies between two given limits resulting in the corresponding variation of the analyzed beam energy. An energy interval of about 100 keV can be scanned easily. The counts from up to six detectors and pulses from the current integrator are modulated by the saw tooth and can be displayed on the different memory groups of a multichannel analyzer. In addition, the energy calibration also is made on the analyzer by recording the NMR signal as a function of varying magnetic field. Examples of its function are presented.

23918 AUTOMATIC ELECTRONIC PROGRAMMER FOR HANDLING THE MILLISECOND ISOMERS. Garg, K. C.; Khurana, C. S. (Punjabi Univ., Patiala, India). pp 298-300 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The conventional methods of activation analysis involving irradiation of the target and its transportation to the counting system have been successfully applied to long-lived isomers. Fast rabit and pneumatic systems have limited usefulness in the millisecond region. The short interval between two bursts of a pulsed neutron beam can be used for the measurement of half-lives, gamma ray energies, and reaction cross sections of the millisecond isomers. An "Automatic Electronic Programmer" was constructed consisting of electronic circuits that generate and control the series of events during each cycle of operation: neutron bursts, deuteron beam pulsing, simultaneous shuttering of the photomultiplier tube, rest time in which very short lived undesirable activities may decay, and the time the photomultiplier becomes ready for use. At the end of this rest time, the multichannel analyzer starts accepting information about the millisecond activity in the multiscaling mode. With the help of this automatic electronic programmer, it is possible to handle isomers having half-lives in the range from 2 ms to 2000ms. The operation of the programmer coupled with a Van-de-Graaff was fully tested for its stability and reliability.

23919 CONSTRUCTION AND DEVELOPMENT OF A THIN-WALLED HIGH-PRESSURE GAS TARGET. Brotschi, U.; Menetrey, A. (European Organization for Nuclear Research, Geneva (Switzerland)); Watson, R. H. (University Coll., London (UK)). Nucl. Instrum. Methods; 129: No. 1, 39-41(1 Nov 1975).

The note describes the construction and development of thin-walled, high-pressure helium gas targets for a spectrometer which was used to reconstruct the trajectories and measure the kinetic energies of alpha particles recoiling from high-momentum $p + {}^4He$ or $\pi + {}^4He$ collisions. The range of alpha-particle energies involved was between 4 and 80 MeV. (NL)

23920 ASSOCIATED PARTICLE SYSTEM TO PROVIDE A POLARIZED NEUTRON BEAM FROM THE $^2H(d,n)^3He$ REACTION. Galloway, R. B.; Waheed, A. (Edinburgh Univ. (UK)). Nucl. Instrum. Methods; 128: No. 3, 505-513(15 Oct 1975).

An associated particle time-of-flight system for the $^2H(d,n)^3He$ reaction has been developed for studying the scattering of polarized neutrons of about 3 MeV energy. The major problem to be overcome in such a system used with a 0.5 MeV accelerator is that the associated ^3He particles are not substantially more energetic than the deuterons elastically scattered by the target, while the latter are overwhelming in number. An electrostatic analyser has been designed to separate these elastically scattered deuterons from the associated ^3He particles and the quality of its performance is illustrated. Neutron time-of-flight spectra show the performance of the complete system for deuteron energies up to 400 keV. The differential cross section for the elastic scattering of 2.9 MeV neutrons by iron measured using the system is presented as an example of its successful operation. (NL)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

23921 (NP-20768) REPORT OF THE COUNCIL FOR THE YEAR 1974–75. (Science Research Council, London (UK)). 1975. 87p. Dep. NTIS (US Sales Only) $5.00. UK £1.60.

The organization and financing of the Science Research Council and its several activities are described. Separate accounts are given of the work of the research boards, as follows: Astronomy, Space and Radio Board (including astronomy in the radio-, X-ray-, infrared-, visible- and ultraviolet-wavelength regions, cosmic ray research, theoretical astronomy, solar physics, the moon and planets; magnetosphere, ionosphere and atmosphere of the earth); Engineering Board; Nuclear Physics Board (including high energy physics, nuclear structure physics; central facilities, particularly those at the Rutherford and Daresbury Laboratories); Science Board. (UK)

Cosmic Radiation

Refer also to abstracts 23345, 23388, 23403, 23988, 24052, 24080, 24094, 24095, 24127, 24175, 24176, 24180, 24241, and 24981.

23922 (BNL-20925) RADIOACTIVE ISOTOPES ON THE MOON. Davis, R. Jr. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 17p. (CONF-750506-23). Dep. NTIS $3.50.

From symposium on spallation nuclear reactions and their applications in astrophysics and radiotherapy; Philadelphia, Pennsylvania, USA (2 May 1975).

A limited review of experiments and studies of radioactivity and isotope ratios in lunar materials is given. Observations made on the first few millimeters of the surface where the effects of solar flare particles are important, some measurements on individual rocks, and some studies of radioactivities produced deep in the lunar soil by galactic cosmic rays, are among the experiments discussed. (GHT)

23923 (ESRO-SP-106, pp 83-88) SAS-2 OBSERVATIONS OF CELESTIAL DIFFUSE GAMMA RADIATION ABOVE 30 MeV. Thompson, D. J.; Fichtel, C. E.; Kniffen, D. A.; Hartman, R. C. (Goddard Space Flight Center, Greenbelt, MD). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The Small Astronomy Satellite, SAS-2, used a 32-deck magnetic core digitised spark chamber to study γ rays with energies above 30 MeV. Data from four regions of the sky away from the galactic plane ($|b^{II}| > 30°$) have now been analysed. These regions show a finite, diffuse flux of gamma rays with a steep energy spectrum. Within the experimental uncertainties, the flux is uniform over all the regions. Represented by a power law, the differential energy spectrum shows an index of $2.5^{+0.3}_{-0.4}$. A simple power law is not adequate to explain both this data and the existing low-energy gamma-ray data. The steep SAS-2 spectrum and the lower energy data are reasonably consistent with a π^o γ-ray spectrum which has been red-shifted, such as that proposed by some cosmological theories. (auth)

23924 (ESRO-SP-106, pp 89-97) OBSERVATIONS OF DIFFUSE COSMIC GAMMA RADIATION BETWEEN 1.5 AND 10 MeV WITH A BALLOON-BORNE DOUBLE COMPTON TELESCOPE. Schoenfelder, V.; Lichti, G. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Results on the diffuse gamma-ray flux between 1.5 and 10 MeV from a balloon-borne double Compton telescope are presented. The cosmic gamma-ray flux is determined from the flattening of the growth curve near the top of the atmosphere. However, corrections have to be made for inelastic neutron-carbon interactions in the scintillator which cause part of the flattening. The measured cosmic gamma-ray flux exceeds the extrapolation from the x-ray range, if the x-ray spectrum is assumed to be $25\ E^{-2.1}$ photon cm^{-2} s^{-1} sr^{-1} keV^{-1}. If, however, the x-ray spectrum is described by $46\ E^{-2.1}$ photon cm^{-2} s^{-1} sr^{-1} keV^{-1}, then the excess nearly vanishes, except perhaps below 3 MeV. The gamma counting rate from regions of the sky with galactic latitudes between $b^{II} = 0°$ and $b^{II} = -30°$ is constant within statistics. From this constancy, an extragalactic origin can be deduced for more than 77% of the measured diffuse flux. (auth)

23925 (ESRO-SP-106, pp 107-116) MEASUREMENTS OF THE 0.1 TO 27 MeV COSMIC γ-RAY SPECTRUM BY APOLLO 15 AND 16. Peterson, L. E. (Tata Inst. of Fundamental Research, Bombay); Trombka, J. I.; Dyer, C. S.; Matteson, J. L. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The spectrum of diffuse cosmic γ-rays over the 0.1–27 MeV range has been measured by a 7 × 7 cm omnidirectional NaI counter on Apollos 15 and 16. Location of the spectrometer on a 7.6 m extensible boom, use of precision pulse-height analysis, and operation in several modes permitted data to be obtained from which spacecraft and other background contributions could be separated. Recent measurements have tended to verify the Apollo spectrum. (auth)

23926 (ESRO-SP-106, pp 117-124) ENERGY SPECTRUM OF THE DIFFUSE COMPONENT OF COSMIC X- AND γ-RAYS. Tanaka, Y. (Nagoya Univ., Japan). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Preliminary results of two experiments concerning the diffuse component of cosmic x- and γ-rays are presented, a rocket observation for the range 5–80 keV, and a balloon observation for the range 100 keV–7.5 MeV. The shutter method provided for unambiguous subtraction of the environmental background. The energy spectrum of the diffuse component exhibits a significant change in slope near 22 keV. In the energy range 20–200 keV, the spectrum is well expressed by $E^{-2.3}$; it seems to flatten above 500 keV, consistent with the possible presence of a bump in the MeV region. (auth)

23927 (ESRO-SP-106, pp 125-133) BALLOON AND SATELLITE OBSERVATIONS OF THE DIFFUSE COSMIC HIGH-ENERGY γ-RAY FLUX. Massaro, E. (Univ., Palermo, Italy); Robba, N. R.; Scarsi, L.; Sironi, G. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Observation of the diffuse cosmic γ-ray flux is difficult because of the background produced locally in the telescope itself by the cosmic radiation interactions and, for balloon-borne experiments, the additional atmospheric contribution. The background characteristics are examined for the various experimental conditions and the possibility is discussed of determining the real value of the cosmic γ-ray flux in relation to the level of the background present. The experimental determinations of the cosmic γ-ray flux at $E\gamma \geq 10$ MeV are analysed and compared. (auth)

23928 (ESRO-SP-106, pp 147-156) ORIGIN OF THE DIFFUSE BACKGROUND γ RADIATION. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, MD); Puget, J. L. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Recent observations have now provided evidence for diffuse background gamma radiation extending to energies beyond 100 MeV. There is some evidence of isotropy and implied cosmological origin. Significant features in the spectrum of this background radiation have been observed which provide evidence for its origin in nuclear processes in the early stages of the big-bang cosmology and tie in these processes with galaxy formation theory. A crucial test of the theory may lie in future observations of the background radiation in the 100 MeV–100 GeV energy range which may be made with large orbiting spark-chamber satellite detectors. The theoretical interpretations of present data, their connection with baryon-symmetric cosmology and galaxy formation theory and the need for future observations will be discussed. (auth)

23929 (ESRO-SP-106, pp 157-161) MULTIPLE INVERSE COMPTON SCATTERING AND THE DIFFUSE X-RAY COMPONENT. Bui-Van, A.; Hurley, K. (Univ., Toulouse). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

It is shown that, when multiple scattering is taken into account, the spectrum of inverse Compton produced x-radiation is different from the single-scatter spectrum. In particular, the γ-ray fluxes in the 1–10 MeV region can increase by a factor of about three over the single-scatter spectrum. The significance of this result with respect to the diffuse cosmic x-ray flux is discussed. (auth)

23930 (ESRO-SP-106, pp 163-169) DETECTION OF γ-RAYS AND THE POSSIBLE EXISTENCE OF ANTIMATTER ON A UNIVERSAL SCALE. Omnes, R. (Paris Univ., Orsay, France). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Some important physical processes can occur if the universe contains as much matter as antimatter. One such possibility is a phase separation between nucleons and antinucleons within thermal radiation at very high temperatures. A second is the occurrence of a surface tension between matter and antimatter during the radiative period. The consequences of these effects, which have a bearing on the amount of matter in the universe, on galaxy formation, on γ-ray background and on the energy mechanism of quasars, are briefly described. (auth)

23931 (ESRO-SP-106, pp 171-173) LARGE-AREA BALLOON-BORNE γ-RAY DETECTOR. Jenkins, T.; Albats, P.; Frye, G.; Kolman, R.; Schindler, S.; Schreiner, R.; Thomson, G.; Mace, O. (Case Western Reserve Univ., Cleveland). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

A γ-ray detector which is presently being constructed at Case Western Reserve University is described. The detector is designed to be sensitive to γ-rays above 10 MeV and will have an effective area of about 1 m^2 at 8% efficiency. A multiwire proportional counter array will provide data on the direction of the secondary electrons from which the direction of the initiating photon may be inferred. (auth)

23932 (ESRO-SP-106, pp 175) γ-RAY EXPERIMENT FOR THE FRENCH D2B γ SATELLITE. Hurley, K. (CESR, Toulouse). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The D2B γ experiment will be launched in 1976 by CNES on a French "Diamant" launcher. The scientific objectives of the programme are to study x- and γ-ray sources in the 20 keV–2 MeV energy range, as well as the diffuse x- and γ-ray components from 20 keV to 10 MeV. The problems usually encountered in this type of experiment are connected with background created in the satellite itself and insufficient detector collimation and shielding. These problems have been minimized in the D2B γ experiment by using a satellite with a small mass, choosing an almost equatorial orbit with an altitude of 500 km, using a new type of detector whose directionality above 300 keV does not depend on shielding, but rather on comparing counting rates in two crystals in a telescope-like arrangement. This allows the elimination of γ-ray background produced in the satellite, which is especially useful for the detection of monoenergetic γ-rays from discrete sources. (auth)

23933 (ESRO-SP-106, pp 177-184) UCSD/MIT HARD X-RAY AND LOW-ENERGY γ-RAY EXPERIMENT FOR HEAO-A. Matteson, J. L. (Univ. of California, San Diego); Pelling, R. M.; Peterson, L. E. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

HEAO-A, scheduled for launch in April 1977, will carry four large instruments designed to measure x-rays and γ-rays in the 0.15 keV–10 MeV range. The spacecraft and instruments are briefly described and the UCSD/MIT Hard X-Ray and Low Energy γ-Ray Experiment is described in detail. This instrument will operate over the 10 keV–10 MeV range using an array of seven NaI (Tl)/CsI (Na)phoswich detectors and eight large CsI(Na) shields. Detector events are pulse-height-analyzed into 64 or 512 channels with a selectable time resolution of 10^{-1}, 5×10^{-3} or 2×10^{-5}s. The instrument background is expected to be comprised of approximately equal parts of diffuse γ-rays entering the aperture, radioactive decay of spallation products and γ-ray leakage through the shields. Detailed background predictions are presented. Sensitivity estimates indicate that the Crab Nebula should be detected up to ~5 MeV. ~1% isotropy limits for the diffuse component of cosmic γ-rays should be achieved and its spectrum measured with improved precision. (auth)

23934 (ESRO-SP-106, pp 185-193) SENSITIVE TELESCOPE FOR LOW-ENERGY γ-RAY ASTRONOMY. Meccagni, D. (Univ., Milan); Paizis, C.; Perotti, F.; Stiglitz, R.; Villa, G.; Bailey, P.; Dean, A. J.; Ramsden, D. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

A Compton coincidence detector within a semi-active shield is described and optimization of detector design is discussed. Sources of background include atmospheric γ rays, neutron-induced events, and spallation. (BJG)

23935 (ESRO-SP-106, pp 201-204) SAS-2 OBSERVATIONS OF γ-RAYS FROM THE GALACTIC PLANE. Thompson, D. J.; Bignami, G. F.; Fichtel, C. E.; Hartman, R. C.; Kniffen, D. A. (Goddard Space Flight Center, Greenbelt, MD). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Preliminary data are given for the SAS-2 high-energy (>100 MeV) galactic γ-ray observations. These data include both latitude and longitude distributions. The longitude distribution shows a high-density region for $330° < l^{II} < 40°$. The latitude distributions toward the center and the anticenter are markedly different, the former showing a two-component structure of half-widths of ~3° and ~6°, respectively. The energy spectrum in the range 35–200 MeV is hard, consistent with cosmic-ray interactions with interstellar matter, including π^0 decay and emission from energetic electron interactions. The data is consistent with an interpretation in terms of the confienment of the cosmic rays in the spiral arms. (auth)

23936 (ESRO-SP-106, pp 205-209) γ-RAY OBSERVATIONS OF THE SKY FROM THE TD-1 SATELLITE. Voges, W. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.); Pinkau, K.; Koechlin, Y.; Leray, J.; Boella, G.; Sironi, G. Nov 1974. From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Experiment S-133 on board the ESRO satellite TD-1 has observed the sky for high-energy (≳30 MeV) γ rays for a total period of about one year. To date, 30–40% of the data have been analyzed and they have begun to reveal the γ-ray emission features of our Galaxy. In the course of this analysis, several problems connected with the background and the automatic scanning and processing of data telemetred from the spark chamber have had to be overcome. The problems encountered in spark-chamber γ-ray telescopes will be briefly discussed. (auth)

23937 (ESRO-SP-106, pp 211-216) HIGH-RESOLUTION OBSERVATION OF γ-RADIATION FROM THE GALACTIC PLANE. Samimi, J. (Univ. of Mashhad, Iran); Share, G. H.; Kinzer, R. L. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Previously published results have indicated that the γ-radiation emitted from the galactic plane, in the direction of the center may predominantly be confined to a ~3° wide band lying along the Equator. Additional data analyzed from the same experiment are consistent with this finding. The narrow emission region implies that a dominant part of these galactic photons are either generated at distances >4 kpc from Earth or that they are not produced uniformly across the assumed ~220 pc thick disc. Implications of this result for recent models describing the γ-ray emissivity of the Galaxy are discussed. New data continue to provide evidence for an enhanced emission from the plane in the interval $350° < l^{II} < 360°$. Evidence is also presented for the existence of a soft component of galactic photons which dominates over the π^0-decay γ-rays below 50 MeV. Plans to fly a modified version of this experiment are discussed. (auth)

23938 (ESRO-SP-106, pp 217-220) γ-RAY SPECTRUM FROM THE GALACTIC DISC ABOVE 200 MeV. Sood, R. K.; Bennett, K.; Clayton, P. G.; Rochester, G. K. (Imperial Coll., London). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

A telescope sensitive to γ-rays in the energy range 200 MeV–8 GeV has been flown on a balloon launched from Longreach, Australia. The flight included a scan of the Galactic Center region ($330° < l^{II} < 30°$, $-10° < b^{II} < 10°$) and partial analysis of the data shows a signal from this part of the sky of $(4.1 \pm 1.5) \times 10^{-5}$ photon/cm^2 s rad between 500 MeV and 1 GeV. (auth)

23939 (ESRO-SP-106, pp 221-227) INTERPRETATIONS OF THE GALACTIC γ-RAY DISTRIBUTION. Dodds, D. (Univ. of Durham, Eng.); Strong, A. W.; Wolfendale, A. W.; Wdowczyk, J. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

High cosmic-ray fluxes, or high molecular hydrogen densities in the region 4-6 kpc from the Galactic Center may be responsible for the observed distribution of galactic γ-rays. Most of the proposed mechanisms for increased cosmic-ray fluxes appear to conflict with radio data, and explanation in terms of high gas densities must be considered as more probable at the present time. An estimate of the expected inverse Compton contribution to the γ-ray flux is made. (auth)

23940 (ESRO-SP-106, pp 229-239) INVERSE COMPTON γ-RAYS FROM THE GALACTIC DISC. Cowsik, R.; Voges, W. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The results of a calculation of the energy and space distribution of γ-rays in the bandwidth 100 keV-300 MeV arising from the various processes in our Galaxy are presented. The processes considered are the Compton scattering of the 2.7 K background photons and the starlight by cosmic-ray electrons, and also the decay of neutral pions produced in the nuclear interaction of cosmic-rays with the interstellar matter. Particular emphasis is given to the strong increase in the density of stellar photons close to the Galactic Center. This leads to a peaking of the γ-ray fluxes in the direction around the center. The calculated spectral shapes and the angular distributions are in agreement with the available observations in the bandwidth ~10−100 MeV. The possibility of experimental observation at lower energies is discussed, as are some recent models proposed for explaining the hard γ-ray emission from our Galaxy. (auth)

23941 (ESRO-SP-106, pp 259-263) INTERPRETATION OF THE GALACTIC RADIO-CONTINUUM AND γ-RAY EMISSION. Beuermann, K. P. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

An analysis is performed of the nonthermal radiocontinuum and γ-ray emission of the galactic disc, using a spiral-arm model of the Galaxy. The results for the 408 MHz brightness temperature and the >100 MeV γ-ray line intensity as a function of galactic longitude at $b^{II} = 0°$ are presented. The observational implications, as well as the uncertainties in the calculations, are briefly discussed. An estimate of the possible range of the inverse Compton contribution to the observed γ-ray flux is made. (auth)

23942 (ESRO-SP-106, pp 265-271) HIGH-ENERGY COSMIC γ-RAYS IN THE SOUTHERN HEMISPHERE. Frye, G. M. Jr. (Case Western Reserve Univ., Cleveland); Albats, P.; Thomson, G. B.; Hopper, V. D.; Mace, O. B.; Thomas, J. A.; Staib, J. A. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Pulsed 20 MeV γ-rays from the Vela pulsar were detected on a November 16, 1972, balloon flight with a time-averaged flux of 1.5×10^{-5} MeV cm^{-2} s^{-1} MeV^{-1}. Evidence is also seen for γ-radiation from the Large Magellanic Cloud. A comparison with OSO-7 x-ray surveys indicates that at least some of the galactic plane γ-rays are from point sources. (auth)

23943 (ESRO-SP-106, pp 273-277) OBSERVATIONS OF DISCRETE γ-RAY SOURCES WITH SAS-2. Thompson, D. J.; Fichtel, C. E.; Hartman, R. C.; Kniffen, D. A.; Bignami, G. F. (Goddard Space Flight Center, Greenbelt, MD). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The SAS-2 γ-ray telescope has observed a significant (8σ) excess from the direction of the Crab Nebula. The flux above 100 MeV is found to be $(3.2 \pm 0.9) \times 10^{-6}$ cm^{-2}s^{-1}. Timing data indicate that a large fraction of this flux is pulsed. An excess in the galactic radiation from the Vela region gives a flux of $(5.0 \pm 1.2) \times 10^{-6}$ cm^{-2}s^{-1} above 100 MeV when analyzed as a discrete source, with a very flat energy spectrum as from a π^0-decay origin. The excess from the Vela region could reflect either a large-scale galactic feature, such as a superposition of spiral arm segments, or it could be associated with the Vela supernova remnant. If the excess is attributed to cosmic rays released from this supernova interacting with the interstellar matter in the region, then of the order of 3×10^{50} erg would have been released in the form of energetic cosmic rays. Three low-energy γ-ray bursts have been observed in the SAS-2 anticoincidence shielding. (auth)

23944 (ESRO-SP-106, pp 307-322) COS-B EXPERIMENT FOR γ-RAY ASTRONOMY. Bignami, G. F.; Boella, G.; Burger, J. J. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The COS-B satellite will carry a single large experiment, capable of detecting γ-rays with energies in excess of 20 MeV in order to study in detail the sources of extraterrestrial γ-radiation. The principal objectives of the study will be to investigate the angular structure of γ-ray emission from the galactic plane, to measure the flux of the isotropic radiation from high galactic latitudes believed to be of extragalactic origin, to examine known or postulated point sources of the radiation and to determine the energy spectra of all identified sources. The experiment features a 16-gap spark chamber for the identification and determination of the arrival direction of the γ quanta, a caesium-iodide energy calorimeter for energy determination, a telescope defining the field of view of the experiment, and a plastic-scintillator anticoincidence shield for the rejection of charged particles. Also included is a proportional counter sensitive to x-rays in the 2-12 keV range, to synchronise on the possible short-period pulsations of γ-ray emission from sources detected to pulsate at x-ray wavelengths. The eccentric orbit will permit observations for 80% of each orbital period, when the satellite is outside the radiation belts. The attitude control and measurement system enables the experiment to be pointed in almost any desired direction with the attitude known to better than 0.5°. An operational life of two years is foreseen so that 24 targets can each be studied for approximately one month. (auth)

23945 (ESRO-SP-106, pp 339-344) DETERMINATION OF γ-RAY DIRECTION OF INCIDENCE IN γ-RAY ASTRONOMY SPARK CHAMBERS. Shukla, P. G.; Mayer-Hasselwander, H. A. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

In γ-ray astronomy experiments in the energy range 20 MeV to several GeV, the spark chamber has become an important tool: ESRO TD-1A and NASA SAS-2 satellites carrying spark chambers have already provided a large amount of data on cosmic γ-rays. In mid 1975, ESRO's γ-ray astronomy satellite COS-B, which carries a single experiment containing a wire spark chamber with magnetic core memory, will be launched. In connection with this experiment, empirically several alternative methods for the extraction of the best possible value for direction from the spark-chamber pictures are studied. The results of this study are presented here and the optimum procedure suggested for the orbital data analysis is discussed. (auth)

23946 COSMIC RAY ANTIPROTON AND POSITRON PRODUCTION IN THE INTERSTELLAR MEDIUM. Badhwar, G. D.; Golden, R. L.; Brown, M. L.; Lacy, J. L. (NASA Johnson Space Center, Houston, Texas, USA). Astrophys. Space Sci.; 37: No. 2, 283-300(Oct 1975).

The energy spectra of cosmic ray secondary antiprotons and positrons have been calculated using the latest available data on inclusive reactions. Using the measured positron spectrum, it has been found that the amount of matter traversed by the cosmic rays in the few GeV region to be m approximately 4.7 ± 1.5 g cm^{-2} of interstellar hydrogen. The computed antiproton to proton ratio is about 4×10^{-4} for energies 5−10 GeV. This is sufficient to make observations of antiprotons feasible from balloon flights. The type of information that can be obtained if accurate information of the spectra of these two components becomes available has also been pointed out. (NL)

23947 COSMIC RAY INTENSITY VARIATIONS. Pomerantz, M. A.; Duggal, S. P. (Franklin Inst., Swarthmore, PA). Antarct. J. U. S.; 10: No. 5, 224-225(1975).

Cosmic ray storms are investigated in an attempt to establish a correlation between the north–south asymmetry and solar and space data. Particular attention is paid to the relationship between the north–south anisotropy and the inclination of the associated shock waves with respect to the ecliptic plane. (BJG)

23948 DETECTION AND STUDY OF INTENSITY VARIATIONS OF COSMIC RAYS OF THE INTERPLANETARY AND MAGNETOSPHERIC ORIGIN FROM THE DATA OF THE GLOBAL NETWORK OF OBSERVATORIES. Dorman, L. I.; Sergeev, A. V. Kosm. Luchi; No. 15, 5-12(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Principal types of cosmic ray intensity variations and their characteristics are investigated. The structure of the equation

describing the principal variation types is studied. Special features of the variations of cosmic rays of interplanetary and magnetospheric origin in the period between March 25 and April 9, 1958, are also investigated. (auth)

23949 SOLAR MODULATION OF GALACTIC COSMIC RAYS OF MODERATE AND LOW ENERGY. Nikolaev, Yu. M. Kosm. Luchi; No. 15, 40-71(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

The paper deals with spherically symmetric diffusion of cosmic rays in the region of supersonic solar wind flow. Intensity modulation depends on solar activity. Annual and biennial variations of cosmic particle density close to the 1965 minimum are studied. The diffusion coefficient is specified as a product of power functions of rigidity and of distances. Analytical solutions for the diffusion equation are obtained. Experimental data of the stratospheric and direct cosmic measurements of variation amplitudes and of the differential energy spectrum allow to determine dimensions of the modulation region and the particle energy spectrum beyond the modulation region. (auth)

23950 METEOR EFFECT IN COSMIC RAYS. Bel'skii, S. A. Kosm. Luchi; No. 15, 75-81(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Data on meteor effect in cosmic rays for the years 1957–1968 are presented. The paper proves the existence of a meteor effect of an increase in cosmic ray intensity in the periods immediately after and preceding the solar activity maximum in 1958–1959 and September 1967–September 1968 respectively. A number of the observed local cosmic ray intensity variation occurrences, such as Forbush decreases, increases at the time of a Forbush decrease minimum, are considered to be manifestations of meteor variations of cosmic ray intensity due to separate meteor showers. We also believe that the solar and the galactic cosmic ray modulation caused by a cloud of magnetic inhomogeneities (meteor shower orbits taken for the latter) must contribute to the 27-day and 11-year cosmic ray variations. It is noted that meteor showers magnetic fields are some sort of generators of magnetic fields of a sectorial type in the interplanetary space. (auth)

23951 RELATION OF THE DEVELOPMENT OF ACTIVE REGIONS ON THE SUN TO THE ACCOMPANIED PHENOMENA IN COSMIC RAY INTENSITY. Milovidova, N. P.; Nefed'ev, V. P. Kosm. Luchi; No. 15, 82-85(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

To ascertain the peculiarities of the connection between the duration (ΔT_{cr}) and the nature of a decrease in cosmic ray intensity on the one hand with the duration ($\Delta T_{\odot}$) and the nature of the period of activity on the Sun on the other hand the existent situation at different levels of the solar atmosphere has been considered. It was found that $\Delta T_{\odot} \approx \Delta T_{cr}$. The time lag in the initiation of a Forbush decrease in respect to the initiation of an active period depends upon the nature of the sun's active area development. (auth)

23952 MODULATION OF GALACTIC COSMIC RAYS AND SOLAR ACTIVITY DISTRIBUTION OVER HELIOCOORDINATES. Efimov, A. K.; Zusmanovich, A. G.; Kolomeets, E. V.; Shakhova, Yu. A. (Kosm. Luchi; No. 15, 83-89(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

As the interplanetary magnetic field is twisted into an Archimedean spiral and the lines of force pass at a given moment near the Earth beginning in the western part of the solar disc, there should be a high degree of correlation with the activity on the western side of the Sun's hemisphere. The present paper verifies the fact. A conclusion is drawn that the corona radiation is an index which characterizes the influence of the solar activity on the cosmic ray modulation. (auth)

23953 COSMIC RAY INTENSITY VARIATIONS OF THE PERIOD OF 20 TO 70 MINUTES. Chirkov, N. P.; Ipat'ev, V. I. Kosm. Luchi; No. 15, 100-102(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Cosmic ray microvariations with a 18-minute period for 12 MeV energies are observed in the outer space. Microvariations with periods of 20 to 60 minutes according to the 5-minute neutron supermonitor data obtained in Tiksi bay on the 13–18th November, 1968 are discussed. During this time interval a Forbush decrease (November 16th) and a solar cosmic ray flare were observed. (auth)

23954 ANISOTROPY AND SPECTRUM OF SOLAR COSMIC RAYS IN THE INTERPLANETARY SPACE. Miroshnichenko, L. I.; Sorokin, M. O. Kosm. Luchi; No. 15, 118-122(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A model of solar cosmic rays (SCR) propagation including their diffusion, convection and energy variations in the interplanetary space provided that particles escape from a flare region with angular distribution of the type of $\cos^{k}\theta$ is considered. The obtained expressions are analyzed to estimate SCR spectrum variations in space and variations of anisotropy amplitude depending on the type of the initial angular distribution of particles. (auth)

23955 CHOICE OF THE OPTIMAL SIZES FOR A SCINTILLATION SUPERTELESCOPE. Blokh, Ya. L.; Dorman, L. I.; Libin, I. Ya. Kosm. Luchi; No. 15, 123-125(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Selection of optimum dimensions for a scintillation supertelescope is described in the paper. As recording of cosmic ray intensity is carried out in different directions for which the optimum separation distances between the rows are unequal, it is expedient to find such a separation for the supertelescope that will secure minimum losses in the recorded cosmic ray intensity. (auth)

23956 PROGRAM FOR QUALITATIVE ANALYSIS OF NEUTRON MONITOR PERFORMANCE BY MEANS OF SINGLE-FACTOR MODEL. Pimenov, I. A.; Satsuk, V. V. Kosm. Luchi; No. 15, 133-136(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

An algorithm checking neutron monitor performance and based on the use of a single-factor model is described. The check routine realizing this algorithm is also described. The wording of the check-routine has been compiled by using the alfa-language — a subset of the ALGOL-60 language. (auth)

23957 SCINTILLATION SUPERTELESCOPE. Bakatanov, V. N.; Blokh, Ya. L.; Voevodskii, A. V.; Dadykin, V. L.; Dorman, L. I.; Libin, I. Ya. Kosm. Luchi; No. 15, 137-140(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A brief description is presented of a scintillation supertelescope with liquid scintillators. The telescope consists of five sections and permits to make observations of cosmic ray variations from vertical as well as from various inclined directions of particle incidence. (auth)

23958 DIRECTION DIAGRAMS RELATIVE TO AZIMUTHAL AND ZENITH ANGLES FOR SCINTILLATION TELESCOPES OF ARBITRARY GEOMETRY. Blokh, Ya. L.; Dorman, L. I.; Libin, I. Ya. Kosm. Luchi; No. 15, 141-149(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Direction diagrams with respect to azimuthal and zenith angles are necessary to solve some problems related to determination of binding coefficients. Analytical expressions are given for direction diagrams for instruments of arbitrary geometry together with the diagrams obtained by the authors for scintillating telescope which is being developed by IZMIRAN. (auth)

23959 SELECTIVE FILTER FOR STUDY OF COSMIC RAY 27-DAY VARIATIONS. Okhlopkov, V. P. Kosm. Luchi; No. 15, 150-152(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

In studying the 27-day variations a difficulty is encountered associated with the fact that the observed cosmic ray intensity contains not only useful information (various variations) but interference as well and that it is a stochastic process. To distinguish the variation under study linear selective transformations are used in the present paper which allow to intensify the investigated harmonic components. (auth)

23960 STUDY OF ALTITUDE PROFILE AND ANGULAR DISTRIBUTION OF COSMIC RAY INTENSITY. Aleksandrov, V. N.; Blokh, Ya. L.; Dorman, I. V.; Dorman, L. I.; Kashevarov, V. L.; Kuzin, Yu. N.; Libin, I. Ya.; Sorokin, Yu. N.; Khamirzov, Kh.; Shkhalakhov, G. Sh.; Yanke, V. G. Kosm. Luchi; No. 15, 153-163(1975). (In Russian).

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A portable telescope on plastic scintillators has been constructed and manufactured for the purpose of studying the altitude

variations of cosmic ray intensity and for the determination of barometric coefficients of scintillation telescopes, mounted in the Elbrus spectrograph IZMIRAN–KBGU. The portable telescope is also used to determine the absolute cosmic ray intensity at different altitudes and to check the operating capacity of the scintillation telescopes under strained conditions. A brief description is presented of the expedition telescope and the measurement results of the study of the altitude intensity variations and the barometric coefficients of the different cosmic ray intensity components. Results are also given showing angle dependences of barometric coefficients. An analysis is made of experimental data by application of theoretical curves of altitude intensity variations and of barometric coefficients. (auth)

23961 SCINTILLATION DETECTORS FOR RAPID NEUTRONS. Ivanov, R. S.; Myakinin, E. V.; Plokhikh, S. Ya.; Romanov, A. M.; Yur'ev, V. V. Kosm. Luchi; No. 15, 171-175 (1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Investigation of atmospheric neutrons presents great difficulties because of the small magnitude of the neutron flux. The present paper presents a description of the application of phoswiches-scintillation counters with compounded phosphorus-which surpass by far all other methods of recording. (auth)

23962 STUDY OF TEMPERATURE COEFFICIENT FOR THE NEUTRON COUNTERS SNM-15. Kapustin, I. N.; Prilutskii, A. M. Kosm. Luchi; No. 15, 176-177(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Abundant contradictory data on temperature coefficients of boron counters are available in the literature. The temperature coefficient value is determined. (auth)

23963 EXPERIENCE OF COSMIC RAY STATION OPERATING IN APATITY. Vetrina, M. A.; Kuz'min, I. A.; Ustinovich, V. T. Kosm. Luchi; No. 15, 178-180(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A summary of the Apatity cosmic ray station operational experience during the years 1967–1969 is given. A number of recommendations for the improvement of the work of the cosmic ray station are made. (auth)

23964 COMPLETE BLOCK DIAGRAM OF COSMIC RAY STATION OF IONOSPHERE DEPT. OF KAZAKH ACADEMY OF SCIENCE. Egorov, Yu. A. Kosm. Luchi; No. 15, 181-183 (1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A block diagram is considered of a cosmic ray station consisting of a meson azimuthal telescope and a neutron supermonitor placed at different altitudes; the telescope is located at 1300 m above the sea level and the neutron supermonitor at 3340 m above the sea level. The communication between the station units is realized with the aid of a radio-relay station. In addition to cosmic ray intensity registration the station carries out recording of meteorological and geomagnetic data. (auth)

23965 SNM-15 COUNTER EFFICIENCY AND IMPULSE DIFFERENTIAL SPECTRUM FOR VARIOUS BF_3 GAS PRESSURES. Alaniya, M. V.; Blokh, Ya. L.; Georgadze, L. P.; Dolidze, N. I. Kosm. Luchi; No. 15, 184-186(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A group of researchers has developed a large proportional counter of slow neutrons CHM-15. The present paper deals with problems associated with the studies of the differential pulse spectrum and with the effectiveness of the CHM counter depending on the gas pressure in the latter. (auth)

23966 γ-TELESCOPE WITH AN ACOUSTIC SPARK CAMERA. Barsukov, V. T.; Bocharkin, V. K.; Bugakov, I. F. Kosm. Luchi; No. 15, 187-189(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A description is given of the construction of a γ-telescope for the study of spatial and energy distributions of hard γ-rays in the upper layers of the atmosphere. The telescope contains two scintillation counters S_1 and S_2 and a Cerenkov counter connected with a coincidence circuit. Above one of the counters a lead convector is placed which is $\frac{1}{3}$ of the radiation length thick. The Cerenkov counter radiator is made of the TF-1 glass 150 mm (6.3 radiation lengths) thick. The Cerenkov counter pulses are conveyed to a 64-channel amplitude analyzer. In between the scintillation counters five independent sections of a spark chamber SC are placed supplied with acoustic sensors and with windows for spark photography. Detectors S_1 and S_2 of the SC are placed inside the screen scintillator S_3 connected with an anticoincidence circuit. Recording of a γ-quantum corresponds to an event S_1, S_2, $4S_3$. Pulses from 12 acoustic sensors are conveyed into an arithmetical unit. The whole of the information is recorded on a photographic film. (auth)

23967 AZIMUTHAL TELESCOPES OF LARGE EFFECTIVE AREA, BASED ON LIQUID SCINTILLOMETERS. Bakatanov, V. N.; Voevodskii, A. V.; Kozyarivskii, V. A.; Mikheev, S. P.; Stepanov, V. I.; Tulupova, T. I. Kosm. Luchi; No. 15, 207-210 (1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A device of large effective area, based on liquid scintillometers is described. The results are presented of the telescope testing as to merging of counting rates from feeding of discriminator amplifiers and reliability of separate instrumental blocks at prolonged operation; measuring accuracy is evaluated for 360 hours of the device operation. (auth)

23968 PRIMARY PROCESSING OF COSMIC RAY STATION DATA IN REAL TIME SCALE BY MEANS OF NAIRI COMPUTER. Blokh, Ya. L.; Simsaryan, R. A.; Starkov, F. A.; Tipikin, A. P. Kosm. Luchi; No. 15, 203-206(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Elimination of true variations, determination of the instrumental non-stationarity type and rejection of rough data, determination of weighting coefficients, data averaging, determination of data reliability characteristics, making of barometric corrections are discussed. Block diagram of the neutron monitor and description of the program blocks of primary data reduction are presented. (auth)

23969 DEAD TIME EFFECT ON THE SPECTRAL SENSITIVITY OF A SUPERMONITOR. Blokh, Ya. L.; Kapustin, I. N.; Ustinovich, V. T. Kosm. Luchi; No. 15, 164-165(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A conclusion is drawn about the desirability of using three kinds of data in recording the cosmic ray neutron component: data with a short dead time (about 10 microseconds), data with a long dead time (of order 1200 microseconds) and the difference data. (auth)

23970 MULTIPLICITY REGISTER WITH AUTOMATIC CORRECTIONS FOR THE COINCIDENCE EFFECT. Kapustin, I. N. Radkevich, V. A. Kosm. Luchi; No. 15, 166-170(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Multiplicity recording data have been widely used in recent years for the study of the variations of the cosmic ray neutron component. The paper offers a method of multiplicity recording with automatic correction of the coincidence effect. (auth)

23971 PROGRAM FOR VERIFICATION OF STATIONARITY OF COSMIC RADIATION INTENSITY RECORDS. Pimenov, I. A.; Satsuk, V. V. Kosm. Luchi; No. 15, 126-129(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A check algorithm for the stability of cosmic ray intensity recording is described as well as the check routine realizing this algorithm. The wording of the check routine has been compiled by using the alfa-language – a subset of the ALGOL-60 language. (auth)

23972 CONVECTIVE TRANSFER EFFECT ON RELAXATION OF GALACTIC COSMIC RAYS. Zakharchenko, V. F. Kosm. Luchi; No. 15, 96-99(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

A nonstationary diffusion equation for cosmic rays is being solved, the convective term being taken in the form given by Dolginov and Toptygin. The relaxation time of cosmic ray intensity for the solar wind region is obtained. For conventional values of the power spectrum exponent the relaxation time with regard for the convective transfer is less than the common diffusion value. Restoration of the cosmic ray density at the solar wind boundary in the presence of a very thick turbulent layer is considered. The characteristic restoration time turned out to depend on the inner radius of the turbulent layer and on the coefficient of diffusion in it. (auth)

23973 INTERPLANETARY MAGNETIC FIELD FLUCTUATIONS AND THE DIURNAL VARIATION OF COSMIC RAY INTENSITY. Sari, J.W. (Calspan Corporation, Buffalo, N.Y. 14221); Lanzerotti, L.J.; Maclennan, C.G.; Venkatesan, D. Geophys. Res. Lett. 2: No. 12, 571-574 (Dec 1975).

Predictions of the amplitudes of the diurnal variation of cosmic ray intensity, based on calculations of the power spectra of interplanetary magnetic field fluctuations, are compared with measurements of the magnitude of the diurnal variations from Sulphur Mountain neutron monitor data for five solar rotations during mid-December 1965–April 1966, a period during which the interplanetary magnetic field data were also available. The nature of the general agreement between the derived theoretical predictions and the average observed variations over this limited period is pointed out. (auth)

23974 MEASUREMENT OF THE FLUXES OF GALACTIC COSMIC-RAY ^{2}H AND ^{3}He IN 1972–1973. Teegarden, B.J.; von Rosenvinge, T.T.; McDonald, F.B.; Trainor, J.H. (NASA/Goddard Space Flight Center); Webber, W.R. Astrophys. J. 202: No. 3, 815-822 (15 Dec 1975).

This paper reports measurements of the fluxes of cosmic-ray ^{2}H and ^{3}He during 1972–1973 carried out by instruments on board the IMP-7 and *Pioneer* 10 spacecraft. Energy spectra are generally consistent with a positive slope of unity as would be expected for modulated secondary components. A self-consistent data set is proposed spanning the 1965–1973 period wherein all spectra have the same $J \simeq AT$ behavior. Our measured 1972–1973 spectra are compared with calculated interstellar spectra, and it is concluded that only very broad limits can be placed on the amount of modulation. Ratios of the form ^{2}H/^{4}He and ^{3}He/^{4}He are examined and compared with calculated values based on an assumed exponential path-length distribution for galactic propagation. It is concluded that unless extreme assumptions are made about the modulation (e.g., no energy loss), it is impossible to reconcile the simple theory and observation. A nearby source is apparently required to supply enough low-energy ^{4}He to account for the low values of the ^{2}H/^{4}He and ^{3}He/^{4}He ratios. The possible relationship between this source and the recently discovered enhancements of cosmic-ray N and O is discussed. (auth)

23975 NEUTRON-RICH ISOTOPES OF COSMIC RAYS WITH $9 \leq Z \leq 16$. Maehl, R.C.; Fisher, A.J.; Hagen, F.A.; Ormes, J.F. (NASA/Goddard Space Flight Center). Astrophys. J. Lett. 202: No. 3, L119-L123 (15 Dec 1975).

We report here new data on the isotopic composition of cosmic rays with $9 \leq Z \leq 16$ at $T \simeq 450$ MeV per amu. The data show the presence of a considerable neutron-rich component of Mg and Ne, the measured mean masses being 24.3 ± 0.1 and 20.8 ± 0.1, respectively. Coupled with a calculation of the evolution of cosmic-ray isotopic abundances during propagation, these masses indicate that there is probably some neutron-rich material in this charge range at the cosmic-ray source. To explain the Ne mass requires more neutron-rich Ne at the source than is observed in solar system material. This result is discussed in light of recent theories of nucleosynthesis and cosmic-ray propagation. (auth)

Stars

Refer also to abstracts 22938, 23942–23944, 24037, 24048, 24051–24053, 24056, 24103, 24105, 24111, 24113, 24117, 24127, 24131, and 24187–24189.

23976 (ESRO-SP-106) CONTEXT AND STATUS OF γ-RAY ASTRONOMY. Proceedings of Ninth ESLAB Symposium, Frascati, Italy, 10–12 Jun 1974. Taylor, B. G. (ed.). (European Space Research Organization, 92–Neuilly-sur-Seine (France)). Nov 1974. 371p. (CONF-740628–). European Space Research Organization, Neuilly-sur-Seine, France.

Individual abstracts are provided for the 46 presented papers. (BJG)

For abstracts of individual papers see: 23345, 23346, 23923–23945, 23977–23989, 24037, 24094, 24095, and 24185–24189.

23977 (ESRO-SP-106, pp 1-10) COSMIC GAMMA-RAY BURSTS: A REVIEW OF THE OBSERVATIONAL DATA. Strong, I. B. (Los Alamos Scientific Lab., NM). Nov 1974.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of gamma-ray astronomy.

This paper is intended as a general introduction to the session on transient cosmic x- and gamma-ray sources—gamma bursts. Temporal properties will be discussed first, including duration, fluctuation, and frequencies. Energy fluxes and spectral properties are then described together. Finally, the directional data are used to provide estimates of the distance to the sources and the absolute luminosities involved. (auth)

23978 (ESRO-SP-106, pp 11-16) COSMIC γ-RAY BURST MEASURED BY APOLLO 16. Matteson, J. L. (Univ. of California, San Diego); Arnold, J. R.; Metzger, A. E.; Parker, R. H.; Gilman, D. A.; Trombka, J. I.; Peterson, L. F. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

A cosmic γ-ray burst at about 1058:21 UT on April 27, 1972, was detected with an omnidirectional scintillation counter on Apollo 16. The event, whose energy was $\sim 2 \times 10^{-4}$ erg/cm^2, was pulse height analyzed in 512 channels over the $0.067 \leq E \leq 5$ MeV range and shows a complex, multipeak structure on a 300 ms time scale. The burst was also measured by a collimated x-ray detector on Apollo 16, giving spectral data in the 2–8 keV range which, together with a simultaneous observation by Vela 6A, allows a directional determination. (auth)

23979 (ESRO-SP-106, pp 17-24) RECENT MEASUREMENTS WITH A SATELLITE-BORNE COOLED GERMANIUM SPECTROMETER. Part 1. Observations of the 18 December 1972 γ-Ray Burst. Nakano, G. H.; Imhof, W. L.; Reagan, J. B. (Lockheed Palo Alto Research Lab., CA). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Fast time resolution measurements have been made on the γ-ray intensity fluctuations and energy spectra during the early phase of the December 18, 1972, γ burst, which was initially identified by the Vela satellite system. These observations were performed with the first cooled germanium spectrometer flown in space on board the low-altitude polar orbiting satellite, 1972-076B. Counting rates in the energy range 50 keV-3 MeV were observed to increase above background by more than an order of magnitude in a series of pronounced and narrow microbursts which occurred as precursors to the Vela trigger. The microbursts have rise and fall times of about 30 ms with pulse widths typically of about 60 ms which indicate the extent of the microburst source region to be less than $\sim 1.8 \times 10^9$ cm. Furthermore, these microbursts appear to be followed by trailers, i.e. higher intensities after the microburst than before. No significant structure is apparent between ~ 5 μs and 32 ms. The photon spectrum is harder in the more intense microburst, being suggestive of a blackbody spectrum, and softens at later times after the Vela trigger. (auth)

23980 (ESRO-SP-106, pp 25-29) γ-RAY BURSTS OBSERVED FROM OSO-6. Share, G. H.; Meekins, J. F.; Kreplin, R. W. (Naval Research Lab., Washington, DC). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Four cosmic γ-ray bursts were observed above 30 keV by NRL's x-ray spectrometer on board OSO-6 in the period 1969 August to 1972 January. The time histories and energy loss spectra of these events are presented. Data concerning the possible locations of nine of the bursts detected by the Vela satellites in this time period are discussed. The unique source location determined for the event of 1/2/71 from the Vela and Uhuru observations is questioned. (auth)

23981 (ESRO-SP-106, pp 31-36) BURST OF ENERGETIC γ-RAYS. Koga, R.; Simnett, G.; White, R. S. (Univ. of California, Riverside). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

We report a burst of γ-rays with energies greater than 1 MeV that occurred on May 14, 1972, at 201247 UT (151247 local time). The burst had a rise time of 6 ± 3 s, a time duration of 2 min and a decay time of 1 min. It was detected with a tank of liquid scintillator (NE 223) 1 m × ½ m × 15 cm surrounded by a 0.6 cm plastic scintillator in anticoincidence. The detector was flown on a balloon from Palestine, Texas at a float altitude of 4 g/cm^2 residual atmosphere. The signal was 60 standard deviations above a steady background of 6×10^3 count/s. The flux was $0.12^{+0.04}_{-0.04}$ γ/cm^2 s and the time integrated flux 20^{+11}_{-11} γ/cm^2. Only one such event was seen during the 8 h of observation in the daytime on 14 and 15 May. Two sub-flares in Hα occurred during the burst, but not coincident with the start time. A detector on the Solrad satellite observed x-rays on all channels 2 min after the γ-ray start time. This event is similar to three earlier reported events. Our detector was launched 9 h after the burst observed by the Vela satellite. (auth)

23982 (ESRO-SP-106, pp 37-45) PROGRESS IN γ-RAY BURST ASTRONOMY. Cline, T. L.; Desai, U. D. (Goddard Space Flight Center, Greenbelt, MD). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Spectral observations are reported on nine of the 11 known cosmic γ-ray bursts detected from late 1972 through 1973. These events, seven of which are previously unreported, were observed during the first 14 months after October launch of the IMP-7 satellite. All nine events were found to have average event spectra from 100 to 1100 keV that are statistically consistent with being completely alike; the departures from a good fit to the typical spectrum in, at most, two events, can be reconciled as instrumental, due to effects of the eclipsing scan mode. The hypothesis of a single >100 keV average event spectrum for all γ-ray bursts, inferred from IMP-6 observations of the intensity maxima of 5 earlier events [Cline et al., 1973], is thereby considerably strengthened. In addition to the mutual consistency of these 14 IMP events, all independently reported average event spectra also fit the IMP-7 common spectrum; these include an Apollo-16 event [Metzger et al., 1974] and one of the same events reported here, in which spectral variations with time are reported [Imhof et al., 1974]. This observed lack of variability of the average event spectrum suggests that the production mechanism is tied to more rigidly fixed source parameters than most celestial or solar hard x-ray phenomena. Other characteristics of GRB events, suggested by these observations, include a high-energy spectral tail with power-law index −2.5, a rising size spectrum from the earlier event rate of 5 yr^{-1}, 8 yr^{-1} at somewhat greater sensitivity, and a hint of clustering of event occurrence in time. (auth)

23983 (ESRO-SP-106, pp 47-50) γ-RAY BURSTS: AN OUTLINE OF CURRENT THEORIES. Pacini, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The main theoretical arguments explaining the origin of cosmic γ-ray bursts are outlined. Both local and extragalactic models are considered. The local models include such production mechanisms as stellar superflares, sudden accretion of matter into neutron stars (or black holes), neutron star glitches, and other mechanisms. Supernova explosions, fast cooling of a newly formed neutron star, and early evolution of radio-outbursts in variable sources are three possible extragalactic models. (BJG)

23984 (ESRO-SP-106, pp 51-55) X-RAY CAMERA FOR THE DETECTION AND LOCALIZATION OF γ-RAY BURSTS. Helmken, H.; Gorenstein, P.; Gursky, H. (Harvard College Observatory, Cambridge, MA). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The observation of γ-ray bursts has been one of the significant new discoveries of astronomy. Whatever their eventual explanation, it is likely that the bursts represent a new kind of astronomical object not previously known nor predicted from other observations. Precise locations will be an essential factor in obtaining optical or radio counterparts. A novel type of detector system known as a multiple-pinhole camera offers an ultimate capability of 1'' angular resolution with sensitivity several orders of magnitude better than the present satellite systems. These properties make this type of detector highly likely to be included in burst observations for future satellite and Space-Shuttle missions. (auth)

23985 (ESRO-SP-106, pp 57-62) CAPABILITY OF COS-B TO MEASURE COSMIC γ-RAY BURSTS. Boella, G.; Gorisse, M.; Paul, J.; Taylor, B. G.; Wills, R. D. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

By virtue of the large area of the detector, in conjunction with the appropriate electronics, COS-B is sensitive to γ bursts down to a few % of typical bursts previously observed. Burst onset times can be determined to ~1 ms and with the flexible data-handling system a wide variety of burst profiles can be studied with a time resolution of 1.6 ms and good statistical accuracy. A determination of the energy spectrum of a burst can be undertaken, because of the limited buffer size and the nonuniformity of the ACO due to its geometrical configuration. (auth)

23986 (ESRO-SP-106, pp 63-68) DETECTOR FOR γ-RAY BURSTS. Brabban, D. H. (Univ. of Birmingham, Eng.); Simnett, G. M.; Dean, A. J.; Ramsden, D. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

A balloon-borne detector for γ-ray bursts is described. The active elements are arrays of plastic scintillator and collimated NaI (Tl) crystals. The measurements will include the time structure, arrival direction and evolution of the energy spectrum (25 keV−2.5 MeV) of the bursts. During quiet times, the diffuse γ-ray background will be studied. It is proposed to fly the detector both on a conventional 1 day balloon flight and on a long trans-Atlantic balloon flight. (auth)

23987 (ESRO-SP-106, pp 69-76) FUTURE SATELLITE EXPERIMENTS FOR GAMMA-BURST OBSERVATIONS. Evans, W. D. (Los Alamos Scientific Lab., NM). Nov 1974.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of gamma-ray astronomy.

Based on the presently available data, certain objectives for future satellite experiments are identified. Methods for achieving these objectives and the requirements they impose on instrument design and program coordination are described. Some of the experiments planned for launch during the next few years are discussed and the extent to which they will satisfy the objectives is considered. (auth)

23988 (ESRO-SP-106, pp 279-285) OBSERVATIONS OF SOUTHERN SKY γ-RAY SOURCES AT $E\gamma \geq 3 \times 10^{11}$ eV. Grindlay, J. E. (Smithsonian Astrophysical Observatory, Cambridge, MA); Helmken, J. F.; Hanbury Brown, R.; Davis, J.; Allen, L. R. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

In accordance with the results of our previously reported survey observations (1972) of eleven candidate γ-ray sources at $E\gamma \geq$ 300 GeV, we have continued observing the most promising objects in 1973 and 1974. The Narrabri optical reflectors were again used to detect the atmospheric Cerenkov light from extensive air showers with the double-beam technique enabling partial cosmic-ray rejection. An improved timing system was employed and detected pulse heights were recorded so that spectral information is available. Preliminary results are presented, including evidence for the detection of Cen A (NGC-5128). Possible source models and some implications are discussed. (auth)

23989 (ESRO-SP-106, pp 353-362) γ-RAY SOURCE PULSATING PATTERN "SYNCHRONIZATION" VIA SIMULTANEOUS X-RAY OBSERVATION IN THE COS-B MISSION. Boella, G.; Buccheri, R.; Burger, J.; Coffaro, P.; Paul, J. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The COS-B satellite has been instrumented with an x-ray proportional counter detector operating in the energy range 2−12 keV, known as the "Pulsar Synchroniser," in order to search for possible pulsed γ-ray emission from sources identified as pulsars in the x-ray range. The source pulsation period and phase in the satellite reference frame are determined by the x-ray synchroniser for observation time intervals short enough to eliminate the need for corrections for Doppler effect along the satellite orbit and drifts of the on-board clock. The continuously updated values of the local period and phase are then used for the time analysis of the source emission in the γ-energy range for which the expected observation time can last up to several days. The phase analysis method developed has been tested with Monte-Carlo-simulated x-ray data for a spectrum of period values, pulse structure and source intensities. The equipment providing a pulsating x-ray flux has been used to test the overall instrument response and the method of analysis. (auth)

23990 NON-STATIONARY ONE-DIMENSIONAL PROBABILISTIC RADIATIVE TRANSFER IN A BOUNDED MEDIUM. Grappin, R. (Observatoire de Paris, Section de Meudon, 92 (France)). Astrophys. Space Sci.; 37: No. 2, 383-400(Oct 1975).

Monochromatic time-dependent diffusion of a photon in a homogeneous bounded medium is considered as a one-dimensional probabilistic process in a medium with absorbing boundaries. Simple and intuitive relations are shown to exist between Laplace transforms of time-dependent distributions of photons in infinite medium and inside a bounded medium, as well as for the corresponding emerging intensities. One obtains, in particular, an explicit and exact expression for the original time-dependent distribution inside a bounded one-dimensional medium. (NL)

23991 MASS DIFFERENCES AND CONVECTIVE MIXING IN WHITE DWARFS. Boehm, K. H. (Kiel Univ. (F. R. Germany)). Astrophys. Space Sci.; 37: No. 2, L7-L11(Oct 1975).

Very different amounts of convective mixing are predicted for DA and for non-DA white dwarfs if the recently determined

mass differences between these two classes of stars are accepted. Using convection zone models calculated by Fontaine (1973) it is shown that this effect contributes strongly to the atmospheric abundance differences provided DA and non-DA stars have originally comparable total hydrogen abundances. (NL)

23992 ORION-2: FIRST SCIENTIFIC RESULTS. Gurzadyan, G. A. (Garny Space Astronomy Laboratory, Erevan, USSR). Space Sci. Rev.; 18: No. 1, 95-139(Oct 1975).

41 refs.

The ultraviolet spectral images of thousands of faint stars up to the 13th mag., in the wavelength region of 2000-5000 A are obtained by means of the space astrophysical observatory Orion-2 aboard the spaceship Soyuz-13. These spectrograms were designed generally for an investigation of the continuous spectra of the stars in ultraviolet. The processing and measurement of part of the material available confirm the expectations for the solution of a large number of problems concerning the physics of stars and stellar atmospheres. Some of the results obtained are included in the present review. (NL)

23993 DYNAMICAL EFFECTS OF SUPERNOVAE ON THE INTERSTELLAR MEDIUM. I. Spherical Shock Waves in an Adiabatic Medium. Dyson, J. E.; Gulliford, P. (Manchester Univ. (UK)). Astrophys. Space Sci.; 37: No. 2, 477-498(Oct 1975).

An interstellar cloud suddenly overrun by a supernova blast wave experiences a very rapid increase in boundary pressure. A shock wave propagates into the cloud. As a preliminary investigation, the propagation of spherical shock waves in an adiabatic medium is studied numerically. (NL)

23994 STELLAR STABILITY IN NEWTONIAN THEORY OF GRAVITATION WITH SHADOW EFFECT. Chiang, C. C.; Hamity, V. H. (Max-Planck-Institut fuer Physik and Astrophysik, Munich). Nuovo Cim.; 30B: No. 2, 280-290(11 Dec 1975).

The Newtonian theory of gravitation with shadow effect is applied to discuss the conditions for hydrostatic equilibrium and stability of stellar models. In particular, a uniform-density spherical star model is analyzed in some detail. It is found that the critical adiabatic index for stability is always smaller than $\frac{4}{3}$, in contrast to what happens in ordinary Newtonian theory. Possible generalizations of the theory as well as its applications in astrophysics are briefly indicated. (auth)

23995 Uv-EXCESSES OF CEPHEID VARIABLES. Nikolov, N. S. (Bulgarian Acadeny of Science, Sofia. Department of Astronomy); Ivanov, G. R. (Peoples Astronomical Observatory, Varna (Bulgaria)). Astron. Nachr.; 295: No. 5, 207-216(1974).

On the basis of the intrinsic $(U-B)_0$ colors of the cepheid variables the UV-excesses in the maximum and minimum light $\delta(U-B)^{max}$ and $\delta(U-B)^{min}$ are defined. It is found out that the UV-excesses in the maximum light increase with the period P, but there is no correlation between $\delta(U-B)^{min}$ and log P. A correlation between $\delta(U-B)^{max}$ and the amplitude defects f_B is also determined. These results as well as the possible causes of the UV-excesses are discussed.

23996 UBV PHOTOMETRY OF THE LMC CLUSTER NGC 1466. Penny, A. J. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Not. R. Astron. Soc.; 172: No. 3, 65P-67P(Sep 1975).

UBV electronographic photometry of stars in the LMC globular cluster NGC 1466 down to V = 21m indicates that the giant branch stars have an ultraviolet excess of 0.32m ± 0.09m, showing that the cluster is very metal poor. The horizontal branch has a magnitude of V = 18.8m, implying a distance modulus of 18.2m. (auth)

23997 PHYSICAL PROPERTIES OF THE RED GIANTS IN NGC 2420. Osborn, W. (Inst. of Astronomy, Merida, Venezuela). Mon. Not. R. Astron. Soc.; 172: No. 3, 631-637(Sep 1975).

The effective temperatures, surface gravities, and masses of 11 red giant members of the old open cluster NGC 2420 have been derived from existing intermediate-band photometry on the David Dunlap Observatory system. The mean mass of the stars was found to be 0.7 $M_\odot$. The data permit the helium abundance of the cluster to be estimated and result in the value Y = 0.30. (auth)

23998 SPECTROGRAPHIC STUDY OF BETA CENTAURI. Lomb, N. R. (Univ., Sydney). Mon. Not. R. Astron. Soc.; 172: No. 3, 639-647(Sep 1975).

Using spectra obtained in 1969, it is shown that the radial velocity of β Cen was varying with a period of 0.157d in 1969. The broad spectral line profiles of the star are examined for changes in shape with the above period. This search is considerably complicated by the fact that the star is a single line spectroscopic binary with components of approximately equal brightness; as in such a binary, spurious variations may be caused by the variation in the velocity of one component with respect to the other. However, with the help of a series of graphs of predicted blended profiles it is demonstrated that, for the observations under discussion, any variations found are likely to be intrinsic to the star. Variations in the profiles are, in fact, found with the radial velocity period; the phase relations between the changes in the profiles and the radial velocity curve are the same as in the narrow lined β CMa stars. (auth)

23999 RADIAL VELOCITIES OF SOUTHERN EARLY-TYPE STARS AT INTERMEDIATE GALACTIC LATITUDES. Kilkenny, D.; Hill, P. W. (St. Andrews Univ., Eng.). Mon. Not. R. Astron. Soc.; 172: No. 3, 649-665(Sep 1975).

Radial velocities for 68 early-type stars at intermediate galactic latitudes are presented. The velocity-longitude diagram indicates that most of the OB stars out of the plane participate in galactic rotation. An apparent deviation from circular galactic rotation already reported for Ca II, H I and H II regions near the plane is also present in the intermediate latitude observations of interstellar Ca II and is probably due to large scale motions in the – I arm. Several high-velocity and run-away stars are briefly discussed. (auth)

24000 NEW PHOTOMETRIC METAL ABUNDANCE AND LUMINOSITY CALIBRATION FOR FIELD G AND K GIANTS. Jennens, P. A.; Helfer, H. L. (Rochester Univ., NY). Mon. Not. R. Astron. Soc.; 172: No. 3, 667-679(Sep 1975).

Photometry of 260 G and K giants, using a fast broad-intermediate band photometric system (UBViyz system) is used to calibrate chemical composition, [Fe/H], luminosity, Mv and color excess, E(B-V). A single S-20 surface photomultiplier is used. The UBVi photometry is transformed to be on the Johnson UBVRI system. Calibrations applicable to the ranges 0.40 < R-I < 0.65 (G2-K3), 0.65 < R-I < 0.90 (K3-K5) are given. A photometric luminosity index, Mv(yz), is derived for which rms errors are ± 1 mag. Several indices are calibrated for chemical composition, [Fe/H], and typical rms errors of ± 0.15 in [Fe/H] are obtained for stars of known color excess, E(B-V). For stars of unknown color excess, E(B-V) is determined with an rms error of ± 0.06 and [Fe/H] with an rms error of ~ ± 0.4. For stars with Mv – 1, the errors are larger. (auth)

24001 PHOTOMETRIC METAL ABUNDANCES FOR TWENTY CLUSTERS. Jennens, P. A.; Helfer, H. L. (Rochester Univ., NY). Mon. Not. R. Astron. Soc.; 172: No. 3, 681-694(Sep 1975).

Metal abundances, color excesses and distance moduli have been determined for individual giant stars, using UBViyz photometry, NGC 188, 559, 752, 1245, 1342, 1907, 1912, 2099, 5139 (ω Cen), 5316, 5617, 5822, 5823, 6067, IC 4651, 6819, 6940, 7142, 7261, and 7789. All six clusters with ages 3 to 8×10^9 yr have metal abundances agreeing with one another; their average value of [Fe/H] = – 0.24 ± 0.05, agrees with the average found for the bright K-giants near the Sun. All six clusters are at least 140 pc from the galactic plane. For the younger clusters less than $\sim 10^9$ yr old, one-third are metal deficient. The very young cluster, NGC 559, is probably very metal weak. (auth)

24002 METAL ABUNDANCES FOR K GIANTS IN A FIELD IN SCUTUM. Helfer, H. L.; Jennens, P. A. (Rochester Univ., NY). Mon. Not. R. Astron. Soc.; 172: No. 3, 701-705(Sep 1975).

UBViyz photometric observations of ~100 K giants in a region of Scutum ($l \simeq 25°$, $b \simeq -4°$) out to distances of 10 kpc show that the average value of [Fe/H] for the intrinsically brighter (Mv < 1) K giants along the line of sight is just about the same as that found for the average K giant in the solar vicinity. It is also possible that a group of low luminosity metal-rich stars was detected. (auth)

24003 ARIEL V SKY SURVEY: OBSERVATIONS OF THE ACCRETION WAKE IN VEL X-1. Eadie, G. (Leicester Univ., Eng.); Peacock, A.; Pounds, K. A.; Watson, M.; Jackson, J. C.; Hunt, R. Mon. Not. R. Astron. Soc.; 172: No. 3, 35P-39P(Sep 1975).

Extended observations of the binary x-ray source Vel X-1 (3U 0900-40) have shown a pattern of absorption dips in the x-ray light curve. These are interpreted in terms of attenuation near shock fronts in the accretion wake formed by gravitational focusing of the primary stellar wind by the compact x-ray secondary. Evidence is seen for both the primary shock, as previously reported by Ariel V observations of Cen X-3, and for a secondary shock lying on the up-wind side of the compact star. (auth)

24004 PHOTOMETRY OF LMC X-RAY CANDIDATES. Warren, P. R.; Penfold, J. E. (Royal Observatory, Capetown). Mon. Not. R. Astron. Soc.; 172: No. 3, 41P-47P(Sep 1975).

Stars in the fields of the LMC x-ray sources have been examined in UBV. No statistically signifcant variations were found for LMC X-1 and LMC X-2 but variability of the LMC X-3 candidate is suggested by the data. (auth)

24005 NICKEL AND COPPER IN THE ORION NEBULA. Thackeray, A. D. (Cape Town Univ.). Mon. Not. R. Astron. Soc.; 172: No. 3, 49P-51P(Sep 1975).

The probable presence of three lines of Ni II and one of Cu II in published spectra of the Orion nebula is pointed out. (auth)

24006 ULTRAVIOLET CHROMOSPHERIC LINES IN THE SPECTRA OF LATE-TYPE STARS. Gurzadyan, G. A. (Academy of Sciences, Erevan). Mon. Not. R. Astron. Soc.; 172: No. 3, 617-621(Sep 1975).

The emission lines 2800 Mg II and 3080 Ti II of chromospheric origin have been observed in the ultraviolet Orion-2 spectra of three, G5, K5, and M3 type, stars. This proves the existence of a chromosphere around these stars. The relative radiation powers of the "magnesium" chromosphere for these stars, as well as for the three OAO-2 stars, are presented. The data obtained strongly indicate the existence of stellar chromospheres in the late-type stars with radiation power much higher than the radiative emissivity of the solar chromosphere. The relative emissivity of the stellar chromospheres itself is independent from the spectral type or effective temperature of the star. (auth)

24007 OBSERVATIONS OF CHROMOSPHERIC AND CORONAL EMISSION LINES IN F STARS. Evans, R. G.; Jordan, C.; Wilson, R. Mon. Not. R. Astron. Soc.; 172: No. 3, 585-602(Sep 1975).

The Princeton telescope and ultraviolet spectrograph on the Copernicus satellite has been used to detect chromospheric emission lines of Lyman α, Si III and O VI in the F5 IV star α CMi (Procyon). The interstellar absorption component of Lyman α leads to a H I column density of $\sim 1.6 \times 10^{17}$ cm^{-2} and a value for the neutral hydrogen density in the solar neighborhood of $n_H = 0.015$ cm^{-3}. Mg II h and k emission was detected in Procyon and in the Fo Ib star α Car (Canopus) and the observed widths have been used to evaluate the Wilson-Bappu correlation of line width with luminosity. The analysis of the emission line intensities in Procyon leads to two models of its atmosphere in the range 10^4 to 3×10^5 K, for the limiting cases of high and low electron pressure. In the former case a transition zone (conduction dominated regime) sets in at 10^5 K (cf. 3×10^4 K in the Sun) indicating the existence of a corona whose temperature is deduced to lie in the range 3×10^5 to 6×10^6 K. In the latter case, the model represents a chromosphere over the temperature range observed. (auth)

24008 METAL ABUNDANCES FOR G AND K GIANTS AND SUBGIANTS AT THE SOUTH GALACTIC POLE. Jennens, P. A. (Univ. of Rochester, NY). Mon. Not. R. Astron. Soc.; 172: No. 3, 695-699(Sep 1975).

[Fe/H], Mv and E(B-V) are determined for 72 G and K stars at the South Galactic Pole for which UBViyz photometry has been obtained. Away from the galactic plane the population is dominated by old, low luminosity sub-giants. A strong gradient of [Fe/H] with distance from the galactic plane is detected. (auth)

24009 SOFT X-RAY ASTRONOMY PAYLOAD FOR USE WITH SATELLITES. Kasturirangan, K. (Indian Scientific Satellite Project, Bangalore); Rao, U. R.; Jain, A. K. Indian J. Radio Space Phys.; 4: No. 2, 144-145(Jun 1975).

From symposium on Earth's near space environment; New Delhi, India (18 Feb 1975).

General system considerations for the design of a payload for observations in soft x-ray astronomy using satellites are presented. Analysis of such a system is carried out under three broad aspects: the design of a thin window gas proportional counter system with the associated collimator, the gas control unit with its electronics and the pulse processing circuitry including the telemetry interface. Based on the requirements of sensitivity and low secondary background effects as well as the constraints imposed by spinning satellites from observational standpoint, a viable system is evolved. (auth)

24010 EXACT EQUATIONS FOR AN IDEAL FLUID IN STATIONARY EQUILIBRIUM. Szafron, D.A. (Department of Physics and Astronomy, University of Regina, Regina, Saskatchewan, Canada). Phys. Rev. D 12: No. 12, 4003-4005 (15 Dec 1975).

The exact Einstein equations are given for an ideal fluid in stationary equilibrium. There are six field equations in six unknown components of the metric tensor for the region away from the z axis and four equations plus an integrability condition in the neighborhood of the z axis. (auth)

24011 THE CEPHEID VARIABLES AND THE STELLAR POPULATIONS OF THE DWARF SPHEROIDAL GALAXIES. Norris, J. (Yale University Observatory and Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University); Zinn, R. Astrophys. J. 202: No. 2, 335-345 (1 Dec 1975).

A new hypothesis is presented concerning the stellar populations of the dwarf spheroidal galaxies. We suggest that these systems have evolved separately from our Galaxy, with initial star formation occurring from an extremely metal-deficient protocloud some few billion years after the formation of the Galaxy. By far the large majority of the stars in the dwarf spheroidal galaxies formed at this time, leading to color-magnitude diagrams similar to those of the globular clusters of the Galaxy. The predominantly red horizontal branches of most of these galaxies result from their smaller ages. Little metal enrichment occurred during this initial phase; and later star formation at a substantially lower rate, continuing to about 10^9 years ago, has produced relatively young, quite metal-deficient objects. We show that these may be identified with the Cepheid variables in these systems to give a fully satisfactory explanation of the observed period-luminosity relation of the variable stars. We argue that discrete differences in age between the dwarf spheroidal galaxies and our Galaxy, or helium abundance differences, are incapable of explaining the above-mentioned observations. The existence of Cepheid variables in the Small Magellanic Cloud similar to those in the dwarf spheroidal galaxies probably implies the existence of young, metal-deficient objects ($Z \lesssim 10^{-4}$) in this system. Finally, we suggest that age is the relevant "second" parameter necessary for the interpretation of the anomalous horizontal-branch morphology of the intergalactic globular clusters and those at the edge of the Galaxy. (auth)

24012 ON THE NATURE OF THE BRIGHT VARIABLES IN DWARF SPHEROIDAL GALAXIES. Demarque, P.; Hirshfeld, A.W. (Yale University Observatory). Astrophys. J. 202: No. 2, 346-352 (1 Dec 1975).

Arguments are presented which suggest that the unusual "bright variables" observed in Draco and other dwarf spheroidals are more massive than the RR Lyrae variables in the same systems. Models of very metal-poor stars ($10^{-5} > Z > 10^{-4}$) on the horizontal branch with masses up to $2\,M_\odot$ confirm this interpretation in the sense that both the luminosities and the period-luminosity relation of the models are consistent with the observations of the bright variables. Best fit is obtained for $Y \simeq 0.25$ and $Z \simeq 7\text{–}8 \times 10^{-5}$. Some implications of the presence of stars about 1×10^9 years old in dwarf spheroidal galaxies are briefly discussed. (auth)

24013 SCATTERING BY DUST AND THE PHOTOGRAPHIC APPEARANCE OF ETA CARINAE. Davidson, K. (School of Physics and Astronomy, University of Minnesota, Minneapolis); Ruiz, M.T. Astrophys. J. 202: No. 2, 421-424 (1 Dec 1975).

We have attempted to construct simple isotropic-scattering models which reproduce the apparent surface brightness of the "halo" of η Carinae, as a function of projected radius; unfortunately, the most applicable observational data are now about 30 years old, and improved observations are highly desirable. (auth)

24014 EMISSION ENVELOPES OF T TAURI STARS. Kuan, P. (Kitt Peak National Observatory). Astrophys. J. 202: No. 2, 425-432 (1 Dec 1975).

It is shown that the existence of extended moving envelopes around T Tauri stars can most adequately account for the presence of emission lines. In particular, a single parameter model, i.e., the electron density, or its equivalent, the mass loss rate if the stellar radius and expansion velocity are known, can reproduce the observed intensities of the lower Balmer lines. The excess continuous radiation found in these stars, from the ultraviolet to the near-infrared, can be explained by a model of free-free and free-bound emission from the ejected gas in the form of clumps close to the surface of the star. (auth)

24015 THE LINES He I λ3187 AND He II λ3203 IN O-TYPE STARS. Morrison, N.D. (Institute for Astronomy, University of Hawaii). Astrophys. J. 202: No. 2, 433-438 (1 Dec 1975).

High-dispersion observations of the lines He I λ3187 and He II λ3203 in 19 O and B0.5-type stars are presented. For the purpose of comparing their equivalent widths with the predictions of non-LTE model atmospheres, effective temperatures and gravities of the O-type stars observed are derived from the equivalent widths of other lines of H and He. For supergiants, these temperatures and gravities differ systematically from those derived by the method of spectral classifications, and the reason for the difference is discussed. Theoretical predictions for He I λ3187 have not been made, but the form of the dependence of equivalent width on effective temperature is similar to that predicted for He I λ3889, which arises from the same lower state. For stars with He II λ4686 in absorption, the observed equivalent widths of He II λ3203 agree reasonably well with the theory, except that this line is weaker than predicted in two stars that are hotter than 40,000 K. For three stars with λ4686 in emission, λ3203 is much weaker than predicted. (auth)

24016 RADIATIVE TRANSFER THROUGH A FLOWING REFRACTIVE MEDIUM. Anderson, J.L. (Physics Department,

Stevens Institute of Technology); Spiegel, E.A. Astrophys. J. 202: No. 2, 454-464 (1 Dec 1975).

We discuss the propagation of photons in a nondispersive refractive medium with arbitrary velocity and gravity fields. Photons move along the geodesics associated with the optical metric given by Gordon in the limit where geometrical optics applies. The known properties of geodesics then simplify the task of finding the world lines of photons in a variety of problems. The formalism for describing photon propagation, summarized here, makes it possible to derive a transfer equation for a flowing refractive medium which is formally identical to the relativistic equation of radiative transfer. However, the theory is phenomenological in that it presumes that the index of refraction is specified. (auth)

24017 SOLUTION OF THE COMOVING-FRAME EQUATION OF TRANSFER IN SPHERICALLY SYMMETRIC FLOWS. I. COMPUTATIONAL METHOD FOR EQUIVALENT-TWO-LEVEL-ATOM SOURCE FUNCTIONS. Mihalas, D. (High Altitude Observatory, National Center for Atmospheric Research); Kunasz, P.B.; Hummer, D.G. Astrophys. J. 202: No. 2, 465-489 (1 Dec 1975).

The equation of radiative transfer in the comoving frame makes possible an economical solution of the line formation problem in spherical atmospheres expanding with arbitrarily large velocities. A stable differencing scheme and a frequency-by-frequency elimination procedure have been developed to solve the partial differential equations that describe the radiation field in the comoving frame. Numerical results were obtained for a large number of illustrative models involving line formation by two-level atoms, electron scattering, and continuous absorption. Selected results that simulate situations in the stellar winds of hot stars and similar objects are discussed. In addition to P Cygni and other very broad profiles, extreme center-to-limb variations are obtained that show both limb darkening and limb brightening. For very high velocity flows with very weak or nonexistent continuum and electron-scattering opacities, the flux profiles are very nearly symmetric about the laboratory wavelength and have shapes reminiscent of those observed in the nuclei of Seyfert galaxies. Comparisons are presented between the results of Sobolev-type escape probability calculations and those obtained here. The force of radiation on the gas is examined in a number of situations; the mechanism mentioned by Noerdlinger and Rybicki for the disruption of radiatively driven envelopes in planar geometries is shown to become inoperative for even slightly extended spherical systems. (auth)

24018 THE ESCAPE OF MAGNETIC FLUX FROM A TURBULENT BODY OF GAS. Parker, E.N. (Department of Physics, Department of Astronomy and Astrophysics, University of Chicago). Astrophys. J. 202: No. 2, 523-527 (1 Dec 1975).

Using an idealized two-dimensional model, it is shown through exact calculation of the intermediate field configurations how the magnetic field escapes from the surface of a turbulent body of highly conducting fluid. (auth)

24019 CORE MASS-INTERFLASH PERIOD RELATION FOR DOUBLE SHELL SOURCE STARS. Paczyński, B. (Institute of Astronomy, Polish Academy of Sciences). Astrophys. J. 202: No. 2, 558-560 (1 Dec 1975).

Helium-shell flashes are studied in models of a star of 3 $M_\odot$ with a degenerate core of 0.57, 0.68, 0.97, and 1.374 $M_\odot$. A well-defined core mass-interflash period relation is established. This relation may be combined with the known theoretical core mass-luminosity relation to find a core mass, an intrinsic luminosity, and a distance to an object with known interflash period. An application of this method to FG Sagittae is discussed. A model with a 1.374 $M_\odot$ core developed weak helium-shell flashes every 16 years. (auth)

24020 LEPTONIC-DECAY DISTRIBUTIONS FOR HEAVY-LEPTON PAIRS PRODUCED BY COLLIDING BEAMS. Pi, S.; Sanda, A.I. (Department of Physics, The Rockefeller University, New York, New York 10021). Phys. Rev. Lett. 36: No. 1, 1-4 (5 Jan 1976).

We present a general differential cross section, in the colliding-beam rest frame, for μe-pair production by leptonic decays of a heavy spin-1/2 lepton pair, themselves assumed to be produced via one-quantum annihilation. Our results hold for general, V,A,S,T,P couplings and depend neither on the μe-universality assumption nor on the absence or presence of neutral-current effects. We also present distributions relevant to the events reported by a Lawrence Berkeley Laboratory-Stanford Linear Accelerator Center group. (auth)

24021 EVOLUTION OF RED-GIANT STARS. Sweigart, A.V. (Yale University Observatory, New Haven, Connecticut). Phys. Today 29: No. 1, 25-32 (Jan 1976).

Thermal instabilities in helium-burning shells are linked to the origin of certain elements heavier than iron—in one star the surface abundances of these elements increased by 25 times in the last ten years. (auth)

24022 BEHAVIOR OF GRAINS IN EARLY SUPERNOVA ENVIRONMENTS. Falk, S.W.; Scalo, J.M. (California Institute of Technology). Astrophys. J. 202: No. 3, 690-695 (15 Dec 1975).

The efficiency of grain destruction by collisional and radiative heating and sputtering in a supernova environment is examined. It is found that radiative heating rapidly destroys any grains composed of magnesium silicates, graphite, silicon carbide, iron, or ices. Quartz grains without impurities could survive evaporation, but sputtering and fragmentation should eliminate all but the smallest grains. It is concluded that grains have no observable effect on early supernovae, but that small surviving particles might serve as condensation nuclei during the later phases of the expansion. (auth)

24023 THE SUBSONIC STRUCTURE OF RADIATIVELY DRIVEN WINDS OF EARLY-TYPE STARS. Cassinelli, J.P.; Hartmann, L. (Washburn Observatory, University of Wisconsin-Madison). Astrophys. J. 202: No. 3, 718-732 (15 Dec 1975).

Methods are developed for the calculation of extended nongray model atmospheres for early-type stars with radiatively driven mass loss. Models for a central star of a planetary nebula and a Wolf-Rayet star are calculated, and compared with hydrostatic model calculations. Scaling laws are given for explaining the differences and similarities of stars of different stellar mass. It is found that transonic flow cannot occur if only continuum sources of opacity are present, because a moderate outward increase of the flux mean opacity is required for a physically acceptable structure. Observations of the Of star ζ Pup and the Wolf-Rayet star HD 50896 are summarized that indicate the continuum formation regions are spatially extended. (auth)

24024 ULTRAVIOLET OBSERVATIONS OF COOL STARS. IV. INTENSITIES OF LYMAN-α AND Mg II IN EPSILON PEGASI AND EPSILON ERIDANI, AND LINE WIDTH-LUMINOSITY CORRELATIONS. McClintock, W.; Henry, R.C.; Moos, H.W. (Physics Department, Johns Hopkins University); Linsky, J.L. Astrophys. J. 202: No. 3, 733-740 (15 Dec 1975).

The Princeton spectrometer on the *Copernicus* satellite has been used to confirm the existence of a line width–luminosity relation for the Lα and Mg II λ2800 chromospheric emission lines in K-type stars, by observation of a K2 dwarf (ϵ Eri) and of a K2 supergiant (ϵ Peg). Combined with previously reported observations of lines in three K giants (α Boo, α Tau, and β Gem), the data are consistent with an identical dependence of line-width on absolute visual magnitude for the Ca II K, Lα, and Mg II λ2795 lines. Surface fluxes of Lα, Mg II λ2800, and O V λ1218 (upper limit) for ϵ Eri, and of Mg II λ2800 for ϵ Peg are also compared with values reported previously for the three giant stars. (auth)

24025 PHOTOELECTRIC OBSERVATIONS OF THE MAGNETIC FIELD OF SIRIUS. Borra, E.F. (Hale Observatories, Carnegie Institution of Washington). Astrophys. J. 202: No. 3, 741-742 (15 Dec 1975).

Photoelectric observations of the magnetic field of Sirius do not show evidence of longitudinal magnetic fields greater than a few tens of gauss. (auth)

24026 AN ANALYSIS OF THE SUPERLUMINOUS STAR HR 8752. Luck, R.E. (McDonald Observatory and Department of Astronomy, The University of Texas at Austin). Astrophys. J. 202: No. 3, 743-754 (15 Dec 1975).

A model atmosphere–curve of growth analysis of HR 8752 is presented. An effective temperature of 4000 K is derived from 1973 spectra and is shown to be consistent with photometric data. Gravity-dependent abundances are given, and it is determined that a log $g \simeq -2$ yields the most consistent results. The metal abundances have solar-system values to within the uncertainties; no evidence of s-processing is found in the derived abundances. Non-LTE effects are suggested to be important in Na I, O I, and possibly N I. (auth)

24027 NUCLEAR REACTIONS IN CARBON-RICH STARS. Tassoul, M. (University of Montreal, Department of Physics). Astrophys. J. 202: No. 3, 755-761 (15 Dec 1975).

The combined effect of neutrino losses and of the detailed network of nuclear reactions on the evolution of low-mass, carbon-rich stars is investigated. It is found that models with $0.93\ M_\odot < M < 0.085\ M_\odot$ ignite in a shell which rapidly extends toward the center. For models with $0.95\ M_\odot < M_\odot\ 1.25\ M_\odot$, carbon burning takes place directly in the central region. For both ranges of mass, central combustion is followed by a phase of combustion in an outward-moving shell. For the lower mass range, the end of the evolution is marked by a violent flash; none is observed in the higher mass models which then evolve toward a red giant configuration. (auth)

24028 NUMERICAL STUDIES OF THE AXISYMMETRIC PULSAR MAGNETOSPHERE. Kuo-Petravic, L.G. (Atlas Computer Laboratory, Chilton, Didcot, Oxfordshire); Petravic, M.; Roberts, K.V. Astrophys. J. 202: No. 3, 762-772 (15 Dec 1975).

A numerical model based on the assumption that pulsars are spinning magnetized neutron stars is studied. A two-fluid model which includes

inertial terms coupled self-consistently with Maxwell's equations is used. In this first paper of the series the case with aligned rotation and magnetic axes is examined with the assumption that the only source of charged particles is the star itself. We find that under these conditions the magnetic field lines are closed everywhere and the particles in the equatorial region close to the light cylinder R_L reach sufficiently high energies to escape from the magnetosphere. With the Crab pulsar parameters, 1×10^{38} ergs s^{-1} are carried away by relativistic particles and an equatorial region of high energy density is found near R_L. We make a tentative conclusion that the described behavior is due to the assumption regarding the source of particles which results in 100 percent charge separation and a space-charge-limited emission from the star. In this space-charge-limited regime not enough current is available to open the field lines, but the electrostatic forces are large enough to force motion across the field lines. An artificially large particle rest mass has been used in this paper to ensure a smoother transition between the nonrelativistic and highly relativistic regions of space. Solutions which correspond to an essentially negligible rest mass in the nonrelativistic region will be discussed in subsequent papers. (auth)

24029 THE MAXIMUM MASS OF A COLD NEUTRON STAR. Rosen, J. (Department of Physics and Astronomy, Tel-Aviv University, Ramat Aviv, Israel); Rosen, N. Astrophys. J. 202: No. 3, 782-787 (15 Dec 1975).

The maximum mass of a static cold neutron star is calculated according to the bimetric gravitation theory and according to the general relativity theory for an assumed equation of state containing two parameters. For a certain choice of the parameters the bimetric maximum mass is found to be 8.1 $M_\odot$, while that of general relativity is 1.46 $M_\odot$, the ratio being about 5.6. Changing the parameters changes the masses, but their ratio is nearly constant for a wide range of parameter values. It is pointed out that the process of gravitational collapse in the bimetric theory (which does not admit black holes) is quite different from that in general relativity and may lead to considerable energy emission. (auth)

24030 THE EFFECTS OF REDSHIFTS AND FOCUSING ON THE SPECTRUM OF AN ACCRETION DISK AROUND A KERR BLACK HOLE. Cunningham, C.T. (California Institute of Technology). Astrophys. J. 202: No. 3, 788-802 (15 Dec 1975).

The spectrum of X-rays produced by an accretion disk around a black hole is influenced markedly by Doppler shifts, gravitational redshifts, and the gravitational lens effect. These influences can be described by a "transfer function," which one folds into any assumed spectrum emitted on the disk's surface to get the spectrum observed at various locations far from the disk. This paper formulates such a transfer function and tabulates it for Kerr black holes of $a/M=0$ and 0.9981. The transfer function depends strongly on the polar angle of the observer: An observer near the plane of the disk sees radiation from its hot inner regions to be less redshifted and to subtend a greater solid angle than does an observer near the disk's polar axis. Consequently, the equatorial observer sees a much harder spectrum at high energies than does the polar observer. This effect is more pronounced for black holes of larger angular momentum. (auth)

24031 THE VIBRATIONAL SPECTRUM OF C_3 IN THE 5-MICRON REGION. Treffers, R.R.; Gilra, D.P. (Department of Astronomy, University of California, Berkeley). Astrophys. J. 202: No. 3, 839-843 (15 Dec 1975).

A band near 5 μ has been found in the emission from a carbon tube furnace at 3100 K. It is a broad unresolved feature centered near 1850 cm^{-1} and is about 370 cm^{-1} wide (FWHM). It is shown to be the ν_3 (asymmetric stretch) rotation-vibration band of C_3. A second band at 3200 cm^{-1} is present but weaker; it is possibly consistent with the combination band $\nu_1+\nu_3$. These bands may be opacity sources in cool carbon stars. (auth)

24032 MECHANISM FOR INDUCING SYNCHRONOUS ROTATION AND SMALL ECCENTRICITY IN CLOSE BINARY SYSTEMS. Press, W.H.; Wiita, P.J. (Joseph Henry Laboratories, Princeton University); Smarr, L.L. Astrophys. J. Lett. 202: No. 3, L135-L137 (15 Dec 1975).

Rotation through a tidal bulge generates a fluid shear which, in stars, implies a very high Reynolds number: fully developed turbulence might result. Turbulent viscosities, synchronization, and circularization time scales are computed. The calculation contains no adjustable dimensional parameters. It explains the observed fact of synchronous rotation for orbital periods $\lesssim 4$ days, nonsynchronous for larger periods. The observed small eccentricity of some short-period binary X-ray sources is also an immediate consequence. (auth)

24033 THE DETECTION OF AN Hα ZEEMAN PATTERN IN THE COOL MAGNETIC WHITE DWARF G99–47. Liebert, J. (Department of Astronomy, University of California at Berkeley); Angel, J.R.P.; Landstreet, J.D. Astrophys. J. Lett. 202: No. 3, L139-L143 (15 Dec 1975).

An apparent Hα absorption feature has been detected in image tube scans of the cool magnetic white dwarf G99-47, previously classified as DC (featureless). The broad ~2.5 Å EW line is centered some 21 Å shortword from the normal Hα position. This line is interpreted as the π component of Hα-shifted by the quadratic Zeeman effect in a surface field of $\sim15\times10^6$ gauss. This interpretation is supported by the detection of the characteristic circular polarization of the σ components at ±350 Å in data obtained with the multichannel spectrophotometer. Both results are fitted well by a simple, centered dipole model with a mean longitudinal field of 5.6×10^6 gauss. However, the longitudinal field strength indicated from the continuum circular dichroism theory is about a factor of four smaller. The strength of the Hα absorption and absence of other detectable Balmer and Ca II lines are consistent with G99-47 being a very cool, metal-poor DA star. (auth)

24034 8 Å RESOLUTION SPECTROPHOTOMETRY OF THE PECULIAR A STARS HD 110066 AND HD 133029. Phillips, R.B.; Fix, J.D.; Neff, J.S. (Department of Physics and Astronomy, The University of Iowa). Astrophys. J. Lett. 202: No. 3, L145-L146 (15 Dec 1975).

We have made oversampled spectrophotometric observations of the peculiar A stars HD 110066 and HD 133029 using a bandpass of 8 Å and a channel separation of 3.8 Å. Contrary to the suggestion of Adelman, we find no evidence for bound-free discontinuities near 4200 Å in the spectra of these two stars. We find that the 4200 Å depressions reported by Adelman are caused primarily by well-known blends of atomic lines of elements whose apparent overabundances are consistent with the classified peculiarities of the two stars. (auth)

24035 STATIONARY ELASTIC ROTATIONAL DEFORMATION OF A RELATIVISTIC NEUTRON STAR MODEL. Carter, B. (Observatoire de Paris, Meudon, France); Quintana, H. Astrophys. J. 202: No. 2, 511-522 (1 Dec 1975).

In order to predict pulsar glitch magnitudes in terms of the Ruderman starquake theory, it is necessary to calculate the deviation from perfect fluid behavior when a stationary rotating partly solid neutron star undergoes an elastic deformation due to a change in angular momentum. Previous calculations have been based on crude Newtonian or semi-Newtonian approximations. The present work describes the way to solve this problem exactly (in the small-deformation limit) using a fully relativistic treatment. (auth)

24036 PHOTOELECTRIC MULTIBAND PHOTOMETRY OF M GIANTS AND SUPERGIANTS IN THE BLUE-VISUAL SPECTRAL REGION. Helt, B. E.; Glydenkerne, K. (Copenhagen Univ. Observatory). Astron. Astrophys., Suppl. Ser.; 22: No. 2, 171-192(Nov 1975).

Photoelectric photometry of M stars has been carried out in nine narrow bands in the range from 4050 to 5500 A, and various classification indices based on these observations are discussed. It is shown that six bands define two parameters which clearly separate the spectral type and the luminosity and determine these quantities with an accuracy of about 0.1 subclass and 0.5 mag., respectively. For giants, the value of the color index R–I can be calculated with an accuracy corresponding to that of direct determinations and with practically no effect from interstellar reddening. The spectral type parameter is in good agreement with the TiO index measured by Wing, and the luminosity parameter agrees well with M/sub V/(K) determined by the Wilson–Bappu method. A three-dimensional classification of M stars may be possible by means of the present blue-visual quantities in combination with the infrared TiO and CN absorption indices determined by Wing. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 22942, 23977, 23983, 23988, 24003, 24004, 24030, 24032, 24111, 24120, 24121, 24134, and 24135.

24037 (ESRO-SP-106, pp 345-352) VARIABLE COSMIC X- AND γ-RAY SOURCES. Boella, G. (Univ., Milan); Buccheri, R.; Coffaro, P.; Molteni, D.; Scarsi, L. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

One of the most peculiar characteristics of a large number of the celestial x-ray sources so far identified appears to be the time variability observed in their luminosity. The source intensity versus time profile observed at low x-ray energy (few keV range), where the flux is high enough for a comfortable counting rate at the detector, can be used as a valuable tool for the contemporary detection and identification of the source at higher energies where the luminosity could be too low to allow a significant analysis on its own. Information on the source emission mechanisms can

be derived from a knowledge of the time correlation of the fluxes detected in different energy ranges. The COS-B x-ray detector, operating in the 2–12 keV energy range, could be used to establish the reference time profile for the source analysis at γ energies (E ≥ 20 MeV). Particularly interesting x-ray sources which could become target sources for the COS-B mission will be analyzed. (auth)

24038 RADIO SPECTRA OF FOUR H II REGIONS (ORION B, M8, M16 AND M17). Goudis, C. (Manchester Univ. (UK)). Astrophys. Space Sci.; 37: No. 2, 455-462(Oct 1975).

The radio spectra of Orion B, M8, M16, and M17 are established by using more data over a wider range of frequencies than previous authors. The nature of these objects is discussed. One of these H II regions (M8) may be mixed with non-thermal components. (NL)

24039 COSMIC CHERENKOV EMISSION. Charugin, V. M. (AN SSSR, Moscow. Inst. Kosmicheskikh Issledovanij). Astrophys. Space Sci.; 37: No. 2, 449-454(Oct 1975).

In real intensive cosmic sources it is necessary to take into account the Cherenkov reabsorption which restricts the brightness temperature of Cherenkov emission by energies of emitted relativistic electrons. As Cherenkov optical depth is given by $\tau_c \sim N/E$, the brightness temperature of emission of frequencies near gyrofrequency is determined by electron energy E_r in which $\tau_c(E_r) = 1$. It is shown that most of the synchrotron sources (quasars, pulsars) must be powerful sources of Cherenkov emission. In these sources the high density of low frequency Cherenkov emission can give rise to many parametric effects. (NL)

24040 TWO LUMINOSITY CLASSES OF QUASARS. Jaakkola, T.; Donner, K. J.; Teerikorpi, P. (Helsinki Univ. (Finland). Observatory and Astrophysics Lab.). Astrophys. Space Sci.; 37: No. 2, 301-308(Oct 1975).

Observations of quasars suggest that compact quasars with flat radio spectra belong to the class of dwarf galaxies and extended quasars with steep spectra to the one of bright galaxies. This can be seen also in the associations of quasars with clusters of galaxies, compact quasars occurring in nearby clusters and extended quasars in distant clusters. (NL)

24041 OCCULTATION OF RADIO SOURCE PKS 2025-15 BY COMET KOHOUTEK (1973f). Ananthakrishnan, S.; Bhandari, S. M.; Pramesh Rao, A. (Tata Inst. of Fundamental Research, Bombay (India). Radio Astronomy Centre). Astrophys. Space Sci.; 37: No. 2, 275-282(Oct 1975).

This paper describes the strong fluctuations in the intensity of radio source PKS 2025-15, observed at 327 MHz, during its occultation by comet Kohoutek (1973f) in 1974, January 5. Possible mechanisms which could produce the observed fluctuations are examined. It is difficult to explain the fluctuations in terms of scintillation produced due to the passage of radio waves through the irregular cometary plasma. No detectable radio emission was observed from the comet at 327 MHz. (NL)

24042 MILLIMETER EMISSION FROM EXTRAGALACTIC OBJECTS. I. Observational Techniques and Data Analysis. Rowan-Robinson, M.; Clegg, P. E.; Ade, P. A. R. (Queen Mary Coll., London). Mon. Not. R. Astron. Soc.; 172: No. 3, 603-615 (Sep 1975).

A detailed discussion is given of the observing techniques and method of data analysis for observations in the 1 to 3 mm band. Due to the broadband nature of the observations, the effective frequency depends strongly on the spectral index of the source. The attenuation and noise are well correlated with the precipitable water vapor, as estimated from the groundlevel dew point. Fluxes and upper limits are given for 88 extragalactic sources, of which six (3C 84, 120, 147, 273, M82 and NGC4051) have been detected. The possible detections of 3C 345, 0727-11 and M81 claimed earlier are not confirmed. (auth)

24043 GRAVITATIONAL REDSHIFTS AND ANGULAR DIAMETERS OF COLLAPSED OBJECTS. Das, P. K. (Tata Inst. of Fundamental Research, Bombay). Mon. Not. R. Astron. Soc.; 172: No. 3, 623-630(Sep 1975).

Light propagation from the surfaces and the interiors of static, spherically symmetric collapsed objects with isothermal cores and adiabatically stable envelopes capable of giving high internal gravitational redshifts is studied within the framework of general relativity. Optical appearance and variation of angular diameter are discussed in relation to the equation of state. A method to estimate the mass and the distance of the object from the angular diameter or the period of flux variation has been outlined and illustrated with the example of the QSO 3C 9. (auth)

24044 EMPIRICAL EVIDENCE CONCERNING ABSORPTION LINES AND RADIATION PRESSURE IN QUASI-STELLAR OBJECTS. Burbidge, E.M.; Burbidge, G.R. (University of California, San Diego). Astrophys. J. 202: No. 2. 287-295 (1 Dec 1975).

A critical compilation is given of all absorption-line systems which have so far been identified in quasi-stellar objects. For each QSO all values of R greater than unity were computed, where $R = (1+z_i)/(1+z_j)$ and z_i (but not z_j) includes z_{em}. The resulting histogram is shown in Figure 1. If the absorption-line systems are being driven or held by line-locking or edge-locking mechanisms, the ratios $(1+z_i)/(1+z_j)$ should correspond approximately to the ratio λ_m/λ_n where λ_m and λ_n are the wavelengths of the lines or edges which are locking together. In § IV we consider a number of spectroscopic ratios which are thought to be important. They include the doublet ratios C IV 1550.77/1548.20 = 1.0017 and Mg II 2802.70/2795.52 = 1.0026; the ionization edge ratios N III/C III = 1.009, He II/O III = 1.009, and C II/He I = 1.008; Lβ/H I edge = He II 256/He II edge = 1.125; and the H I/He I ionization edge ratio = 1.808. These ratios are then used to refine Figure 1, and the resulting histogram is shown in Figure 2. Much of the noise has now been removed, since a particular z_{abs}, if its pairing with z_{em} or another z_{abs} can be identified, should not occur in any other pairs unless pair reinforcements are present. In Table 2 we give a list of values of λ_m/λ_n which are likely on spectroscopic grounds to be operating. It is then shown that many of the remaining features of Figure 2 can be explained by some of these pairs. Finally, a discussion is given of the observable consequences of the line- and edge-locking hypothesis. (auth)

24045 SPLITTING OF ABSORPTION LINES IN 3C 191. Williams, P.E.; Strittmatter, P.A.; Carswell, R.F.; Craine, E.R. (Steward Observatory, University of Arizona). Astrophys. J. 202: No. 2, 296-302 (1 Dec 1975).

Spectroscopic observations of the quasar 3C 191 have been made at a higher dispersion than previous studies in an attempt to detect absorption from the excited fine-structure level of the ground state of C II. It was found that the previously studied absorption system is split into two systems ($z_A = 1.945$, $z_B = 1.949$), which show apparent line-locking on the C IV λ 1550 doublet. Both systems show a similar and wide range of ionization. The results are interpreted in terms of a multiple cloud model which is photoionized by a central source, and the possible implications for the ionization structure in QSOs generally are discussed. (auth)

24046 A QUASI-STATISTICAL ANALYSIS OF ABSORPTION-LINE REDSHIFTS IN 4C 05.34. Colvin, J.D. (Department of Physics and Astronomy, University of Rochester). Astrophys. J. 202: No. 2, 303-305 (1 Dec 1975).

The quasi-stellar object 4C 05.34 has a particularly rich absorption-line spectrum. An analysis of this spectrum by Bahcall and Goldsmith identified eight absorption-line redshift systems, ranging in value from $z = 1.7758$ to $z = 2.8751$ (the emission-line redshift is 2.877), and they concluded from an analysis of uniform random number spectra that the identifications are statistically significant. This finding has been questioned. We have reconsidered the question of the statistical significance of these identifications by generating randomized spectra which more closely match the nonuniformities in the line distribution of the observed spectrum, and by analyzing these randomized spectra and the real spectrum in the same way. We find that the absorption-line redshifts in the real spectrum are statistically significant, confirming the finding of Bahcall and Goldsmith. (auth)

24047 RADIATION PRESSURE IN QUASAR CLOUDS. McKee, C.F. (Physics and Astronomy Departments, University of California, Berkeley); Tarter, C.B. Astrophys. J. 202: No. 2, 306-318 (1 Dec 1975).

The effects of ionizing radiation pressure on optically thick clouds are analyzed and the results applied to quasars. Our analysis shows that the radiative acceleration of a cloud is $\lesssim 10$ percent of the fully optically thin value unless the continuum optical depth is very large. The acceleration produced by line absorption is confined to the face of the cloud which is exposed to the incident flux, while the acceleration due to the continuum radiation increases inside the cloud. The disruptive effect of internally created line photons, originally studied by Williams, is analyzed for the case of an optically thick continuum, and it is found that the disruptive acceleration can be greatly enhanced and that it is anisotropic tending to blow off the back side of the cloud. Hence it is concluded that if quasar clouds are radiatively accelerated, they are optically thin; and we show that this result is consistent with the observations. Confinement of the clouds is discussed, and it is shown that photoionized clouds cannot be confined by radiation pressure alone. A model for absorption lines produced by numerous small clouds is developed, and we argue that the absorption lines most likely arise outside the emission-line region. (auth)

24048 THE DISTRIBUTION OF X—RAY SOURCES IN THE GALAXY. II. Johnson, H.M. (Lockheed Missiles and Space Company). Astrophys. J. 202: No. 2, 490-493 (1 Dec 1975).

The distribution of the strongest X-ray sources near the galactic nucleus is consistent with evolved products of massive stars condensed in the past from such rings of dense interstellar matter as are presently

observed to be expanding in the vicinity of the galactic plane from the radii of a few hundred parsecs. Some of the weaker and more dispersed field sources may be aging ex-strong sources. X-ray sources in globular clusters may be derived from stars recently condensed out of the ejecta of evolving red giants in the clusters. (auth)

24049 SPATIAL DISTRIBUTION OF X—RAYS IN THE CRAB NEBULA. Palmieri, T.M.; Seward, F.D.; Toor, A. (Lawrence Livermore Laboratory, University of California); Van Flandern, T.C. Astrophys. J. 202: No. 2, 494-501 (1 Dec 1975).

X-ray measurements made during a lunar occulation of the Crab Nebula show that the spatial extent of the source is about 100″ in the east-west direction. The center of the X-ray emitting region is about 8″ west of the pulsar. The shape is basically the same when viewed in several energy intervals from 0.5 to 16 keV. The size does not change by more than 30 percent over this energy range. Optical and X-ray intensity distributions are compared, and no optical features other than the pulsar are obvious in the X-ray data. (auth)

24050 VLBI OBSERVATIONS OF THE COMPACT RADIO SOURCE IN THE CENTER OF THE GALAXY. Lo, K.Y.; Schilizzi, R.T.; Cohen, M.H.; Ross, H.N. (Owens Valley Radio Observatory, California Institute of Technology). Astrophys. J. Lett. 202: No. 2, L63-L65 (1 Dec 1975).

A compact radio source at the galactic center has been detected at 3.7 cm on a very long baseline interferometer composed of the Goldstone 64-m and the Owens Valley 40-m telescopes (separation 242 km). The source has an angular size, θ_s, on the order of or less than 0″02, corresponding to a linear size $\lesssim 200$ AU or 10^{-3} pc, at the distance of the galactic center (10 kpc). The measured flux density is 0.6 ± 0.1 Jy. The brightness temperature of the source is 3×10^7 K if $\theta_s \simeq 0''02$. Comparison with previous high-resolution observations of the galactic center suggests time variation in the flux density. The nature of the compact radio source is discussed. (auth)

24051 DETECTION OF X—RAY EMISSION FROM STELLAR CORONAE WITH ANS. Mewe, R.; Heise, J.; Gronenschild, E.H.B.H.; Brinkman, A.C.; Schrijver, J.; den Boggende, A.J.F. (The Astronomical Institute, Space Research Laboratory, Utrecht, The Netherlands). Astrophys. J. Lett. 202: No. 2, L67-L71 (1 Dec 1975).

With the soft X-ray detector aboard the Astronomical Netherlands Satellite (ANS) we have searched for soft X-ray emission in the range 0.2–0.284 keV from hot stellar coronae. X-ray emission has been detected from Capella (α Aur) and Sirius (α CMa). For 26 other stars (main sequence, subgiants, giants, and supergiants) upper limits to the X-ray luminosity have been obtained. The physical conditions of a corona needed to explain the observations are discussed. (auth)

24052 EVIDENCE FOR X—RAY EMISSION FROM FLARE STARS OBSERVED BY ANS. Heise, J.; Brinkman, A.C.; Schrijver, J.; Mewe, R.; Gronenschild, E.; den Boggende, A. (The Astrophysical Institute, Space Research Laboratory, Utrecht, The Netherlands); Grindlay, J. Astrophys. J. Lett. 202: No. 2, L73-L76 (1 Dec 1975).

Observations that detected the first X-ray emission from flare stars are described. An X-ray flare was detected from YZ CMi at 0.28 keV and ~1–7 keV, although no optical or radio coverage was available. During a very large optical flare from UV Ceti, X-ray emission at (only) 0.28 keV was detected. Upper limits for X-ray emission from several small optical flares of UV Ceti are presented. Implications for X-ray flare models, the diffuse X-ray background, and low-energy cosmic-ray flux are mentioned. (auth)

24053 SEARCH FOR CONTINUOUS X—RAY EMISSION FROM NP 0532. Wolff, R.S.; Kestenbaum, H.L.; Ku, W.; Novick, R. (Columbia Astrophysics Laboratory, Columbia University). Astrophys. J. Lett. 202: No. 2, L77-L81 (1 Dec 1975).

A search for continuous X-ray emission from the pulsar NP 0532 has been performed using lunar occultations and high temporal resolution. No increase in the nonpulsed phase of the flux from the Crab Nebula was observed when NP 0532 was exposed. The result is used to establish an upper limit of 4.7×10^6 K (99% confidence) on the surface temperature of the neutron star. (auth)

24054 COMPACT COMPONENTS IN A COMPLETE SAMPLE OF EXTRAGALACTIC RADIO SOURCES. Broderick, J.J.; Condon, J.J. (Department of Physics, Virginia Polytechnic Institute and State University). Astrophys. J. 202: No. 3, 596-602 (15 Dec 1975).

A statistically complete sample of 100 extragalactic sources stronger than 2 Jy at 1400 MHz was observed on a 3.5×10^6 wavelength baseline at 430 MHz. The unresolved pulsar AP2016 was used to normalize the fringe visibilities, with the result that all extragalactic sources appear at least partially resolved. In general, sources with flat spectra ($\alpha < +0.5$) show fringes, while steep-spectrum sources do not, confirming that flat spectra are produced by synchrotron self-absorption rather than unusual electron-energy distributions. The spectral index-luminosity relation for radio galaxies is shown to reflect differing electron-energy distributions rather than self-absorption. Nearly all quasars, even those with steep spectra, contain components brighter than 10^{10} K. Purely radio "identifications," made by calling fully resolved sources galaxies and sources showing fringes quasars, agree with 80 percent of the available optical identifications. (auth)

24055 SPECTRAL INDEX DISPERSION IN EXTRAGALACTIC RADIO SOURCES. Peterson, F.W. (National Radio Astronomy Observatory). Astrophys. J. 202: No. 3, 603-609 (15 Dec 1975).

By assuming synchrotron radiation losses to be an important process, even in the straight spectra of extragalactic radio sources with spectral index between −0.5 and −1.1, and by introducing a different distribution in electron energies, the observed dispersion in spectral indices can be related to a dispersion in magnetic field strengths of the sources. (auth)

24056 MASSES FOR VELA X-1 AND OTHER X—RAY BINARIES. Avni, Y. (Weizmann Institute, Rehovot, Israel); Bahcall, J.N. Astrophys. J. Lett. 202: No. 3, L131-L134 (15 Dec 1975).

We report a detailed analysis of the optical light curve and other previously known observations of the X-ray binary Vela X-1 (3U 0900–40). All constraints are consistent only with a projected orbital velocity of the X-ray source of between 200 and 300 km s^{-1}. We estimate the allowed ranges of the masses and other parameters. If the mass of the X-ray source is less than the Chandrasekhar limit for white dwarfs, then the optical star must have an unusually small mass-to-radius ratio for its spectral type. The importance of the X-ray eclipse duration in determining binary parameters is emphasized, and some new results are presented from analyses of the observations of 3U 1700–37 and other X-ray binaries. (auth)

Solar Phenomena

Refer also to abstracts 23388, 23949–23955, 23981, 24018, 24181, and 24212.

24057 (AD/A-005821) A LABORATORY SOLAR FLARE NEUTRAL POINT EXPERIMENT. Final Report, 7 September 1971–6 December 74. White, R. S.; Baum, P. J.; Bratenahl, A. (California Univ., Riverside (USA). Inst. of Geophysics and Planetary Physics). Jan 1975. 178p. (IGPP-UCR-75-1). NTIS $7.00.

Experimental studies are included for: the reconnection process; admittance probe measurements in the double inverse pinch device; x-ray and electron spectra from the double inverse pinch device; plasma instability at an x-type magnetic neutral point; mass motion and heating in a magnetic neutral point system; spectrum of turbulence at a magnetic neutral point; effect of obstacles on the rate of reconnection of magnetic field lines; impulsive flux transfer events and solar flares; and confinement by a triple inverse pinch. (GRA)

24058 (COM-75-10501) INTRODUCTION TO SOLAR–TERRESTRIAL PHENOMENA AND THE SPACE ENVIRONMENT SERVICES CENTER. Technical Report. Mangis, S. J. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Space Environment Lab.). Jan 1975. 70p. (NOAA-TR-ERL-315; SEL-32). NTIS $4.25.

Paper copy also available from GPO as C55.13:ERL 315-SEL32.

This report is an introduction to solar–terrestrial phenomena for those with no special background in astrophysics or solar astronomy. Discussions of physics have been kept to a minimum, with emphasis on phenomonology instead. An individual completely unfamiliar with solar events should, after reading this volume, be able to read and understand the SESC Report and Forecast of Solar Geophysical Activity and be able to apply its contents to his particular area of concern. This volume is also intended as a quick reference work for Skylab ATM Principal Investigator Teams to assist them in using the ATM data book. For that reason, a list of abbreviations used in forecasts and observatory reports is included. Subjects discussed are solar structure and processes, solar activity, and solar–terrestrial relations. There is a brief description of the Space Enevironment Services Center's activities. (GRA)

24059 (COM-75-50193-366-S/SL) SOLAR-GEOPHYSICAL DATA NUMBER 366 (SUPPLEMENT), FEBRUARY 1975. Explanation of Data Reports. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Feb 1975. 89p. (SGD-366(Suppl.)). Paper copy available from National Climatic Center, Attn: Publications, Federal Bldg., Asheville, N. C. 28801. Subscription $34.50/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.40/copy for either part; $1.30 for this extra issue.

See also COM-75-50193-366-1 and COM-75-50193-366-2.

This publication contains the description and explanation of the data contained in the monthly publication Solar-Geophysical Data issued by the Environmental Data Service of NOAA. The data are intended to keep research workers abreast on a timely schedule of

the major particulars of solar activity and the associated interplanetary, ionospheric, radio propagation and other geophysical effects. Data interpreted include alert periods, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, solar wind measurements, solar proton monitoring, interplanetary magnetic and electric fields, solar proton events, solar activity centers, sudden ionospheric disturbances, cosmic rays, geomagnetic activity, radio propagation indices, reduced magnetograms, and flare index by region. An index to volumes for 1957–1974 is included. (GRA)

24060 SOLAR WIND HEATING AT MID-HELIOSPHERIC DISTANCES DUE TO SECONDARY IONS. Fahr, H. J. (Bonn Univ. (F. R. Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung). pp 269-278 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Amongst the various solar wind models that have been discussed in the past the purely hydrodynamical ones proposed in their original form by Parker (1960) are generally favoured up to the present. This is because the main features of the solar wind observed near the Earth's orbit can more satisfactorily be described by this kind of model without the need of too many ad-hoc assumptions. Special disadvantages that could not be overcome in exospheric treatments of the solar wind expansion up to now are that exospheric models are very sensitive to boundary conditions at the solar coronal base and that they do not include mixing of thermal velocities of different orientations to the magnetic field and coupling between thermal velocities of electrons and protons. (NL)

24061 INTERMEDIATE POLARIZATION OF TYPE I BURSTS. Zlobec, P. (Trieste Astronomical Observatory, Trieste, Italy). Sol. Phys.; 43: No. 2, 453-461(Aug 1975).

A constant polarization degree was found in groups of type I bursts having intermediate polarization for all the duration of the group. The same circumstance was verified also for analogous bursts present during a type IV event. The consequences of this behaviour, considering also the results of some recent papers, are discussed. The polarization amount is probably intrinsic to the source itself. (NL)

24062 CYCLOTRON WAVE INSTABILITY IN THE CORONA AND ORIGIN OF SOLAR RADIO EMISSION WITH FINE STRUCTURE. I. Bernstein Modes and Plasma Waves in a Hybrid Band. Zheleznyakov, V. V.; Zlotnik, E. Y. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Radiofizicheskij Inst.). Sol. Phys.; 43: No. 2, 431-451(Aug 1975).

The longitudinal waves (Bernstein modes and plasma waves near the hybrid frequency) in a mixture of equilibrium coronal plasma and a small group of energetic electrons are investigated. The energetic electrons have a nonequilibrium momentum distribution inherent in trapped particles. The frequency dependence of the cyclotron instability increments is studied. Attention is paid to a significant role of the relativistic effects for the cyclotron instability of longitudinal waves. For sufficiently large velocity of nonequilibrium electrons the increments are shown to increase when the hybrid frequency coincides with one of the gyrofrequency harmonics (double plasma resonance). The results obtained are used in Parts II and III to explain "tadpoles" and "zebra" patterns in solar radio bursts. (NL)

24063 SOLAR-FLARE INFRARED CONTINUUM. Ohki, K. (Tokyo Astronomical Observatory, Tokyo, Japan); Hudson, H. S. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Sol. Phys.; 43: No. 2, 405-414(Aug 1975).

Potential sources of infrared (1 μ to 1 mm) continuum in solar flares are considered. Several mechanisms should produce detectable fluxes: in the 350 μ window for ground-based observations, impulsive emission will arise in synchrotron radiation from 1–10 MeV electrons, and possibly thermal (free-free) continuum from the source of the white-light flare; the hot flare plasma responsible for soft X-ray emission will also emit detectable fluxes of free-free continuum in the largest flares. At shorter wavelengths the dominant infrared emission will come from the Hα flare itself. Observations in the infrared wavelengths will help to complete the picture of flare structure in both the impulsive and gradual phases. (NL)

24064 PROPAGATION OF SOLAR-FLARE COSMIC RAYS ALONG COROTATING INTERPLANETARY FLUX-TUBES. Ng, C. K. (Malaya Univ., Kuala Lumpur (Malaysia)); Gleeson, L. J. (Monash Univ., Clayton (Australia)). Sol. Phys.; 43: No. 2, 475-511(Aug 1975).

The propagation of solar-flare cosmic rays along a corotating spiral mean interplanetary magnetic flux-tube is investigated under a variety of initial, inner and outer boundary conditions, by solving the transport equations numerically. The inner boundary condition is shown to have negligible effects on the redistribution of the cosmic rays in interplanetary space, apart from a proportionality constant. The diffusion coefficients have been classified into type I and type II: for type I the peak-along-spiral stays at a finite heliocentric distance, while for type II it travels to infinity. The time dependence of the anisotropy vector is characteristically different in each type and in the case of type I is a function of the observation point. The general propagation characteristics with a free-escape outer boundary are like those of type I. It is shown that closely exponential decay can be produced without a free-escape boundary. The concept of an "equilibrium shape" at late time is introduced. With a source that decays slowly, a maximum and minimum pair appears in the spatial distribution; the maximum subsequently propagates outward and the minimum inward. The impulsive models given do not reproduce satisfactorily all the observed characteristics of solar burst events and a solar source extended in time appears to be indicated. (NL)

24065 OBSERVATIONS OF SOLAR GAMMA RAY CONTINUUM BETWEEN 360 keV AND 7 MeV ON AUGUST 4, 1972. Suri, A. N.; Chupp, E. L.; Forrest, D. J.; Reppin, C. (New Hampshire Univ., Durham (USA). Dept. of Physics). Sol. Phys.; 43: No. 2, 415-429(Aug 1975).

Measurements were made of the time-averaged gamma ray loss spectrum in the energy range 360 keV to 7 MeV by the gamma ray detector on the OSO-7 satellite during the 3B flare on August 4, 1972. The differential photon spectrum unfolded from this spectrum after subtracting the background spectrum and contributions from gamma ray lines is best described by a power law with spectral index of 3.4 ± 0.3 between 360–700 keV and by an exponential law of the form $\exp(-E/E_0)$ with $E_0 = 1.0 \pm 0.1$ MeV above 700 keV. It is suggested that this spectrum is due to non-thermal electron bremsstrahlung from a population of electrons, with a strong break in the spectrum at 2 MeV. Since the observational data indicates that the matter number density must be $n_H \geq 5 \times 10^{10}$ cm^{-3} in the production region, the number of electrons above 100 keV required to explain the results is $\leq 2 \times 10^{34}$. (NL)

24066 CORONAL CONDENSATION OBSERVED AT THE 1973 ECLIPSE. Kurokawa, H. (Kyoto Univ. (Japan)). Sol. Phys.; 43: No. 2, 385-403(Aug 1975).

The flash spectrograms obtained at the June 30, 1973 eclipse contain the monochromatic images of a coronal condensation in three coronal lines of FeXIV 5303, FeX 6374 and FeXI 7892 and Hα line. The assumption of the axially symmetric distribution of the emissivity in the coronal lines allows one to find the density and temperature structure of the coronal condensation. While the electron density in the central axis of the condensation is about ten times as high as that of the normal corona at each height, the temperature is not so high ($T \leq 2.3 \times 10^6$K). This seems to be a representative nature of a coronal active region in the post maximum phase of activity. It is found that there exists a cool and dense core ($T = 10^6$K, $N_e = 6 \times 10^8$ cm^{-3} at 17000 km) at the lower part of the coronal condensation, which is in a close geometrical coincidence with the small active prominence protruding from the underlying plage region. (NL)

24067 EFFECTS OF THOMSON SCATTERING ON THE SHAPE OF A SPECTRAL LINE. Missana, M. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy); Piana, A. (Turin Univ. (Italy)). Astrophys. Space Sci.; 37: No. 2, 263-273(Oct 1975).

The effect of Thomson scattering and Compton effect on the shape of a spectral line is studied in the case of a plane-parallel atmosphere. The theoretical values of red shift and intensity at the top of the line, having an equivalent width $5\sqrt{\pi}10^{-10}$cm, and of the red asymmetry are tabulated for 62 different values of the optical thickness τ'; from $\tau' = 0.2/\sqrt{3}$ to $\tau' = 2.6/\sqrt{3}$. The case of solar atmospheres is considered and it is shown that all main features of the observed red shifts can be interpreted by means of a scattering theory, with an error smaller than one milliangstrom. The need of further measurements is pointed out. (NL)

24068 COMMENTS ON THE PAPER "ON THE RELIABILITY OF THE STRUCTURE OF THE LOW CORONA AS DERIVED FROM FLASH SPECTRA" BY R. GIOVANELLI. Kanno, M. (Kyoto Univ. (Japan)). Sol. Phys.; 43: No. 2, 381-384(Aug 1975).

In spite of the ambiguity in analyzing the eclipse flash spectrum, pointed out by Giovanelli (1975), the general conclusion of Kanno et al. (1971) that coronal emission originated actually in the interspicular region below 10^4 km above the Sun's limb is shown to be still valid. (NL)

24069 RELIABILITY OF THE STRUCTURE OF THE LOW CORONA AS DERIVED FROM FLASH SPECTRA. Giovanelli, R.

(National Measurement Lab., Sydney (Australia)). Sol. Phys.; 43: No. 2, 377-379(Aug 1975).

A study of the photometry of the integrated flash spectrum shows that it is an unreliable method for deriving the structure of the very low corona. (NL)

24070 ENERGY BALANCE IN A MAGNETICALLY CONFINED CORONAL STRUCTURE OBSERVED BY OSO-7. Neupert, W. M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center); Nakagawa, Y. (National Center for Atmospheric Research, Boulder Colo. (USA)); Rust, D. M. (American Science and Engineering, Inc., Cambridge, Mass.). Sol. Phys.; 43: No. 2, 359-376(Aug 1975).

A model of a coronal region of enhanced FeXV and FeXVI emission is developed and its energy balance is examined using extreme ultraviolet observations from OSO-7 together with calculations of possible force-free coronal magnetic field configurations. The coronal emissions overlying the photospheric boundary between regions of opposite magnetic polarity are found to be associated with generally non-potential (current-carrying) magnetic fields in the forms of arches with footprints in regions of opposite polarity. The orientation of these arches relative to the neutral line changes with degree of ionization of the emitting ion (which is inferred from limb observations to be a function of height) and may be evidence of differing electric currents along various field lines. The appearance of a coronal arch, seen side-on, can conveniently be represented by a parabola and a detailed analysis shows this to be a realistic approximation that should be generally useful in analyzing two-dimensional pictures of coronal structures. Applying this analysis to the most prominent coronal region observed in the radiations of FeXV and FeXVI, a maximum is found in the electron temperature, T_e, of 2.6×10^6 K at the top of arches whose heights are 20000-40000 km and whose footpoints are separated by approximately 100000 km. A temperature gradient of approximately 5×10^{-5} K cm^{-1} is found in this coronal structure. Radiative losses are typically fifteen times greater than conductive losses and the energy deposition required to maintain the coronal feature is nearly uniformly distributed along its length. (NL)

24071 INVESTIGATION OF EMISSION LINES OF THE SOLAR CORONA OF 10 JULY, 1972 USING THE FABRY-PEROT ETALON. Kim, I. S.; Nikolsky, G. M. (AN SSSR, Moscow. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln). Sol. Phys.; 43: No. 2, 351-358(Aug 1975).

Coronal interferograms in the lines of Fe XIV 5303 A, He I 5876 A and Fe X 6374 A were obtained during the total solar eclipse of 10 July, 1972. He I emission was found in the chromosphere only. The upper limit of the D_3 equivalent width in terms of the coronal continuous background is 0.013 A in the inner corona (r = 1.15 R(Sun)). The λ 6374 negative was taken with low contrast. The half width of λ 6374 is 1.0-1.08 A for a limited area of the corona (P = 88-104°, r = 1.30-1.44 R(Sun)). A detailed photometry of the 5303 A line was carried out and the behaviour of the half widths and equivalent widths were studied in different regions of the corona. The half width of λ 5303 increases with distance from the Sun's center in almost all the studied regions (1.2 R(Sun) ≤ r ≤ 1.7 R(Sun)). This increase corresponds to an increase of the non-thermal velocities with a gradient of 1-2 km s^{-1} per 0.1 R(Sun). The equivalent widths expressed in the coronal continuous background intensity remain constant on the average. (NL)

24072 OSO-7 RESULTS ON CORONAL EMISSION NEAR 304 A. Nakada, M. P.; Chapman, R. D.; Neupert, W. M.; Thomas, R. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 43: No. 2, 337-350(Aug 1975).

The spectral composition and spatial distribution of equatorial coronal emission near 304 A is examined. Spectral scans indicate that the predominant line is from Si XI. Comparisons of observations with calculations of intensity changes with altitude indicate that collisional excitation is important near the Sun but that photoexcitation becomes dominant beyond about 1.3 R(Sun) from the solar center. Observed and calculated intensities are in approximate agreement for abundances and electron densities that are within the range of observed values. (NL)

24073 TEMPERATURE STRUCTURE AND PRESSURE BALANCE OF MAGNETIC LOOPS IN ACTIVE REGIONS. Foukal, P. (Center for Astrophysics, Cambridge, Mass, (USA)). Sol. Phys.; 43: No. 2, 327-336(Aug 1975).

EUV observations show many active region loops in lines formed at temperatures between 10^4K and 2×10^6K. The brightest loops are associated with flux tubes leading to the umbrae of sunspots. It is shown that the high visibility of certain loops in transition region lines is due principally to a sharp radial decrease of temperature to chromospheric values toward the loop axis. The plasma density of these cool loops is not significantly greater than in the hot gas immediately surrounding it. Consequently, the internal gas pressure of the cool material is clearly lower. The hot material immediately surrounding the cool loops is generally denser than the external corona by a factor 3-4. When the active region is examined in coronal lines, this hot high pressure plasma shows up as loops that are generally parallel to the cool loops but significantly displaced laterally. In general the loop phenomenon in an active region is the result of temperature variations by two orders of magnitude and density variations of around a factor five between adjacent flux tubes in the corona. (NL)

24074 EMERGING FLUX REGIONS. Glackin, D. L. (Hale Observatories, Pasadena, Calif. (USA)). Sol. Phys.; 43: No. 2, 317-326(Aug 1975).

All active regions are born as Emerging Flux Regions (EFRs) which appear in Hα as two small plages of opposite polarity connected by parallel dark arches. After a brief review of the properties of EFRs, new observations of the birth of an EFR and apparent subsequent field reconnection are reported. Flux-rope theories are reviewed and the appearance of EFRs predicted, then the picture is modified on the basis of high resolution observations. A model of this phenomenon that encompasses relevant aspects such as the axial tilt of spot groups, the observed "rotation" of EFRs as they emerge, and the fact that EFR fluxtubes are made up of many discrete strands, is arrived at. The relation of the positions of emergence of EFRs to the chromospheric network is investigated and it is found that new EFRs can be much smaller than supergranules. (NL)

24075 EQUILIBRIUM AND STABILITY OF THE FORCE-FREE MAGNETIC FIELD. II. Stability. Molodensky, M. M. (AN SSSR, Moscow. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln). Sol. Phys.; 43: No. 2, 311-316 (Aug 1975).

The exact limit of stability of force-free fields for the case α = const and spherical region of the disturbances is obtained. The stable fields of active regions must be close to the harmonical ones for length scales which are less than the linear dimensions of spots. (NL)

24076 H AND K LINES IN THE SUNSPOT UMBRA: A SOURCE FUNCTION AND DOPPLER WIDTH. Teplitskaja, R. B.; Efendieva, S. A. (AN SSSR, Irkutsk. Sibirskij Inst. Zemnogo Magnetizma Ionosfery i Rasprostraneniya Radiovoln). Sol. Phys.; 43: No. 2, 293-309(Aug 1975).

An inversion of line profiles H and K Ca II in the umbra of two sunspots is performed. By means of a numerical experiment, a tentative study of possible application of the method of intercomparison of lines in the multiplet (Goldberg's method) is made in cases when the condition of source function equality in multiplet is not fulfilled. It is found that the source functions of H and K lines in the sunspot umbra vary in a monotonous way. Their ratio in the layers for which measured values of $\Delta\lambda_D$ are available differs from unity. In the region of the lower chromosphere under consideration, the Doppler width is decreasing with height. (NL)

24077 LINE RESPONSE FUNCTION OF STELLAR ATMOSPHERES AND THE EFFECTIVE DEPTH OF LINE FORMATION. Beckers, J. M. (Sacramento Peak Observatory, AFCRL, Sunspot, N. M., USA); Milkey, R. W. (Kitt Peak National Observatory, Tucson, Ariz. (USA)). Sol. Phys.; 43: No. 2, 289-292(Aug 1975).

The response function defines the response of line profiles to a depth variation of such atmospheric parameters as velocity, magnetic field and turbulence. The properties of this function are derived and compared with the so-called contribution function. (NL)

24078 CENTER-TO-LIMB VARIATION OF INFRARED PHOTOSPHERIC CARBON LINES AND THE INFRARED CONTINUUM INTENSITY AROUND 1.75 μm. Woehl, H. (Goettingen Univ. (F. R. German)). Sol. Phys.; 43: No. 2, 285-288(Aug 1975).

The center-to-limb variation (CLV) of several infrared carbon lines and the infrared continuum intensity around 1.75 μm were measured. The results were compared with theoretical predictions using four different photospheric models. It was found that the model by Holweger and Mueller (1974) describes the observations best. (NL)

24079 FIVE-MINUTE OSCILLATIONS OF SOLAR EQUIVALENT WIDTHS. Holweger, H. (Kiel Univ. (F. R. Germany)); Testerman, L. (Kitt Peak National Observatory, Tucson, Ariz. (USA)). Sol. Phys.; 43: No. 2, 271-284(Aug 1975).

Equivalent widths of weak and moderately strong Fraunhofer lines observed in an area roughly 3500 × 10000 km in extent are found to show small variations of the order of 1 mA. on a time scale of minutes. The dependence of amplitude on line strength and excitation closely fits that predicted for a compressional disturbance associated with temperature variations that manifest themselves in the equivalent widths. The rms amplitude is about 20K near τ 5000 = 10^{-2}. The equivalent width variations frequently exhibit a 5-min periodicity and are accompanied by prominent oscillations of velocity. Power spectra of both quantities closely resemble each other and demonstrate that most of the equivalent width variations in the range 200 to 500s are due to the thermal response of the atmosphere to 5-min oscillations. A systematic phase lag between velocity and equivalent width is observed, in the sense that temperature leads velocity by an average angle of 120°. This deviates significantly from 90° valid for standing adiabatic waves, showing that in the line-forming layers τ 5000 ~ 10^{-2}, the 5-min oscillations are markedly affected by radiative exchange. (NL)

24080 COMPARATIVE ANALYSIS OF COSMOPHYSICAL AND GEOPHYSICAL PHENOMENA IN 19 AND 20 SOLAR ACTIVITY CYCLES. Dorman, L. I.; Kaminer, N. S.; Kuz'micheva, A. E. Kosm. Luchi; No. 15, 24-29(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

It is concluded that a decrease in solar activity during the 20th cycle as compared with the 19th cycle resulted in a change of the parameters characteristic of the state of the interplanetary medium and of geomagnetic activity. This should be necessarily taken into account while studying Forbush decreases and the preceding increases in cosmic ray intensity. (auth)

24081 SOME ASPECTS OF SOLAR WIND INTERACTION WITH INTERSTELLAR MEDIUM. Salimzibarov, R. B.; Shafer, Yu. G. Kosm. Luchi; No. 15, 72-74(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Effects and processes occurring at the boundary between the solar wind and the interstellar medium are considered. Dimensions of the modulation region are discussed. Characteristics of the solar plasma beyond the standing shock-wave front at the time of and close to the maximum of solar activity are described. (auth)

24082 PROCEDURE TO FORM AN ACOUSTICAL HOLOGRAM OF THE SOLAR SURFACE. Roddier, F. (Nice Univ., 06 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 4, 93-95(28 Jul 1975). (In French)

A procedure is described that should allow photographic recording of the complex amplitude of photospheric oscillations as a function of the position on the solar disk. Underlying acoustic sources might be visualized by observing such a hologram under coherent illumination. (FR)

24083 SOLAR WIND HEAVY ION ABUNDANCES. Bame, S. J., Asbridge, J. R.; Feldman, W. C.; Montgomery, M. D. (Los Alamos Scientific Lab., N. Mex. (USA)); Kearney, P. D. (Colorado State Univ., Fort Collins (USA)). Sol. Phys.; 43: No. 2, 463-473 (Aug 1975).

During periods in 1969-1971 when interplanetary flow conditions were quiet, 17 determinations of the solar wind Fe and Si abundances and 7 of the O abundance were made. On the average [N(Fe)/N(H)] equals 5.3 x 10^{-5}, [N(Si)/N(H)] equals 7.6 x 10^{-5} and [N(O)/N(H)] equals 5.2 x 10^{-4}. Variations from the averages over a total range of factors of approximately 4 for O, approximately 4 for Si, and approximately 10 for Fe have been observed. Although Fe and Si abundance variations appear to be correlated, no other element correlation pairs are unambiguously discernible from the present data set. (NL)

24084 POLARIZATION CHARACTERISTICS OF A GROUP OF SPECTRAL TYPE III SOLAR RADIO BURSTS AT 25 MHz RECORDED ON 14 JULY 1969. Mattoo, S. K.; Bhonsle, R. V.; Alurkar, S. K. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 4: No. 2, 116-119(Jun 1975).

A group of spectral type III solar radio bursts were recorded on 14 July 1969 by a time-sharing polarimeter which had a half-power bandwidth of ± 10 kHz and a time-constant of 1 sec. The dynamic spectra of this event showed super-position of the group of type III bursts on a continuum background radiation. With the help of the polarization parameters, namely, axial ratio, polarization degree and orientation angle, measured at 25 MHz, it is proposed that the burst and background components of radiation originated in different source regions. (auth)

24085 ELECTRIC RESISTIVITY OF ELECTROMAGNETICALLY TURBULENT PLASMA AND RECONNECTION RATE OF MAGNETIC FIELDS. Ichimaru, S. (Department of Physics, University of Tokyo, Bunkyo-ku, Tokyo, Japan). Astrophys. J. 202: No. 2, 528-531 (1 Dec 1975).

The dc electric resistivity of an electromagnetically or magnetohydrodynamically turbulent plasma is expressed in terms of the spectral tensor of the electric-field fluctuations. The result is applied to a calculation of the reconnection velocity u of magnetic fields in the neutral sheet; the calculation, combined with the equipartition of energies between the fluctuating and merging magnetic fields and the plasma, provides a reasonable, microscopic account of Parker's empirical relationship, $u \simeq 0.1\times$ (Alfvén speed). (auth)

24086 TIME-DEPENDENT 2.2-MeV AND 0.5-MeV LINES FROM SOLAR FLARES. Wang, H.T.; Ramaty, R. (NASA-Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. 202: No. 2, 532-542 (1 Dec 1975).

The time dependences of the 2.2- and 0.51-MeV γ-ray lines from solar flares are calculated, and the results are compared with observations of the 1972 August 4 and 7 flares. The time lag between the nuclear reactions and the formation of these two lines is caused by capture of the neutrons and subsequent deceleration of the positrons and decay of the radioactive nuclei. Our main results are that the calculation is consistent with the observed rise of the 2.2-MeV line on August 4, and it does not require different time dependences for the accelerated protons and high-energy electrons in the flare region. The above lags can explain the delayed γ-ray emission observed on August 7. Positrons of energies greater than about 10 MeV could be detected in interplanetary space following large solar flares. (auth)

24087 THE EFFECT OF INTERMEDIATE-SCALE MOTIONS ON LINE FORMATION. Shine, R.A. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 202: No. 2, 543-550 (1 Dec 1975).

The problem of LTE and non-LTE line formation in the presence of velocity fields with geometric scales between the microscopic and macroscopic limits is investigated in the context of periodic sinusoidal and sawtooth waves. For a fixed (LTE) source function the resulting emergent profiles fall between those of the two limits, but in the non-LTE case the intermediate-scale velocity fields can significantly increase the surface source functions and the line core intensities. Calculations are made for a two-level atom in an isothermal atmosphere for a range of velocity scales and non-LTE coupling parameters ϵ. In addition to a maximum line core intensity between the microscopic and macroscopic limits, the relative change in intensity increases as ϵ decreases. Calculations are also made for a hypothetical two-level atom and a four-level representation of Na I in the HSRA solar model. We find that the presence of intermediate-scale velocities in the solar atmosphere could explain the central intensities of the Na I D lines and other strong absorption lines without the high electron densities suggested in some earlier studies. (auth)

24088 DIFFUSION EFFECTS ON THE LINE INTENSITIES OF He I AND He II IN THE SOLAR TRANSITION REGION. Shine, R.; Gerola, H.; Linsky, J.L. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards). Astrophys. J. Lett. 202: No. 2, L101-L105 (1 Dec 1975).

We develop a heuristic treatment of diffusion in the solar chromosphere-corona transition region. We find that diffusion becomes increasingly important with steeper temperature gradients, in active and quiet regions relative to coronal holes, and with increasing excitation potential. Numerical calculations are made for the resonance lines of He I and He II and show that diffusion can enhance these lines. Thus the helium lines may appear relatively weak in coronal holes due to a weakening of the enhancement mechanism. Most transition region lines will be less affected by diffusion than He I or He II. (auth)

24089 INTERPRETATION OF FLARE-PRODUCED PROTON SPECTRA. Rothwell, P.L.; Katz, L.; Yates, G.K. (Air Force Cambridge Research Laboratories, Bedford, Massachusetts 01731); Sellers, B.; Hanser, F.A. J. Geophys. Res. 80: No. 34, 4757-4761 (1 Dec 1975).

Flare-produced proton (1.3–40 MeV) energy spectra from the extramagnetospheric satellite OV5-6 (1969-046B) are examined for the October 29 to November 5, 1972, period. The higher-energy portion of the spectra is further defined by simultaneous measurements obtained from the polar-orbiting satellite S72-1 (1972-076B). A turnover in the spectra below ~4 MeV is observed. The spectral shape is examined in terms of either (1) dE/dx losses in a chromospheric/coronal storage region or (2) adiabatic deceleration with an energy-dependent interplanetary diffusion coefficient ($K_{\parallel}$). It is concluded that the data are consistent with dE/dx losses if the protons were stored at an altitude of $\leq 3\,R_s$. We also examined the possibility of adiabatic deceleration in the solar wind. An order of magnitude calculation indicates that $K_{\parallel}$ (10 MeV) ~7.5×10^{21} cm^2/s, a value too high for diffusion-convection to be a viable explanation for the observed spectral shape. (auth)

24090 THE INTENSITIES AND PROFILES OF XUV TRANSITION ZONE LINES IN A QUIET SUN REGION COMPARED TO A POLAR CORONAL HOLE. Feldman, U.; Doschek, G.A.; Tousey, R. (E. O. Hulburt Center for Space Research, Naval Research Laboratory). Astrophys. J. Lett. 202: No. 3, L147-L150 (15 Dec 1975).

The intensities of XUV transition zone lines from limb spectra of a quiet sun region and a polar coronal hole are compared. The spectra were obtained from the NRL slit spectrograph on *Skylab*, and cover a region from $-12'$ within the limb ($1' \simeq 725$ km) to $+20'$ above the limb. The lines selected for comparison are formed at temperatures that range from 3.6×10^4 to 2.2×10^5 K. Lines of the higher temperature ions, e.g., O V, are significantly less intense in the coronal hole, and lines of lower-temperature ions show little change. Profiles of selected optically thin transition zone lines from the quiet Sun and coronal hole spectra are also shown. The lines are broader than expected in ionization equilibrium, and bulk motion velocities are deduced from the widths of the lines. There appears to be little, if any, statistically significant difference in the velocities obtained from the quiet Sun and the coronal hole. (auth)

24091 LIMB-BRIGHTENING CURVES OF XUV TRANSITION ZONE LINES IN THE QUIET SUN AND IN A POLAR CORONAL HOLE OBSERVED FROM *Skylab*. Doschek, G.A.; Feldman, U.; Tousey, R. (E. O. Hulburt Center for Space Research, Naval Research Laboratory). Astrophys. J. Lett. 202: No. 3, L151-L154 (15 Dec 1975).

Solar limb-brightening curves are discussed for XUV spectral lines formed in the upper chromosphere and transition zone of a quiet Sun region and a polar coronal hole. The spectra were recorded by the NRL slit spectrograph on *Skylab*. The lines considered are emitted from ions formed within the temperature range from 10^4 K to 2.2×10^5 K. The limb-brightening curves cover a region from $-4'$ within the limb ($1' \simeq 725$ km) to $+20'$ above the limb. The data from $0'$ to $+20'$ are compared with predictions based on both homogeneous and inhomogeneous models of the transition zone. The limb-brightening curve of the O I line at 1355.6 Å indicates that O I is formed in spicules. The limb brightening of the He II line at 1640.4 Å is consistent with a temperature of formation between $\sim4\times10^4$ K and $\sim9\times10^4$ K for He II. (auth)

24092 LACK OF EVIDENCE FOR SOLAR-CYCLE VARIATIONS IN HIGH-SPEED STREAMS IN THE SOLAR WIND. Vasyliunas, V.M. (Department of Physics and Center for Space Research, Massachusetts Institute of Technology). Astrophys. J. Lett. 202: No. 3, L159-L160 (15 Dec 1975).

The observed yearly numbers and durations of high-speed streams in the solar wind previously reported by Intriligator, when normalized to the duration of available observations, do not exhibit a significant systematic variation with the solar cycle, contrary to the inference drawn by Intriligator. (auth)

24093 SOLAR ABUNDANCE OF PLATINUM. Burger, H.; Aller, L. H. (Univ. of California, Los Angeles). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 11, 4193-4195(Nov 1975).

Three lines of neutral platinum, located at lambda 2997.98 A, lambda 3064.71 A, and lambda 3391.86 A have been used to determine the solar platinum abundance by the method of spectral synthesis. On the scale, log A(H) equals 12.00, the thus-derived solar platinum abundance is 1.75 +- 0.10, in fair accord with Cameron's value of log A(Pt) equals 1.69 derived by Mason from carbonaceous chondrites and calculated on the assumption that log A(Si) equals 7.55 in the sun. (auth)

Galaxies

Refer also to abstracts 23939–23942, 23976, 23988, 24011, 24012, 24017–24019, 24022, 24048–24050, and 24053.

24094 (ESRO-SP-106, pp 249-252) GALACTIC DISTRIBUTION OF GAS, MAGNETIC FIELD AND COSMIC RAYS. Paul, J.; Casse, M.; Cesarsky, C. J. (CEN, Saclay, France). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The purpose of this work is to see if it is possible to reconcile quantitatively ideas on galactic spiral structure, structure of the galactic magnetic field, containment of cosmic rays by fields, and of fields by matter, in quasi-hydrostatic equilibrium. In this context, a model has been constructed in which the relation between gas density, cosmic-ray density and magnetic field is assumed to be maintained throughout the galactic disc. The galactic synchrotron and γ-ray emissions expected from this model are presented and compared with the observations. (auth)

24095 (ESRO-SP-106, pp 253-257) RADIO AND γ-RAY EVIDENCE FOR A MOLECULAR-ARM FEATURE AT 5 kpc FROM THE GALACTIC CENTER. Solomon, P. M. (Inst. for Advanced Study, Princeton, NJ); Stecker, F. W. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Recent measurements of the galactic CO distribution as evidenced from 2.6 mm radio observations of the CO emission line intensity by Scoville and Solomon reveal a striking correlation with an unfolding of the SAS-2 measurements of galactic γ-ray emission. Both distributions may be indicative of a ring-shaped distribution or arm consisting of cool clouds of molecular hydrogen at a galactocentric distance of ~ 5 kpc. The mean density of H_2 in this region is estimated to be between 1 and 5 cm^{-3}. Both a galactic and extra-galactic origin of cosmic rays are consistent with the observations, although the presence of dynamical effects and increased star formation at 5 kpc in the dense molecular clouds may also be connected with an increase in cosmic-ray production. (auth)

24096 ABUNDANCE OF NEGATIVE HYDROGEN IN SMALL HOT INTERSTELLAR CLOUDS. Rudkjoebing, M. (Aarhus Univ. (Denmark)). Astrophys. Space Sci.; 37: No. 2, 371-381(Oct 1975).

The observed intensities of the diffuse interstellar absorption band at λ 4430 have minimum values, for given stellar distances, that are equivalent to the reddening caused by the small Ambarzumian-type clouds studied by B. Stroemgren. This indicates that there is no negative hydrogen present between these clouds, which are then identified with the hot H I phase of interstellar matter. The equilibrium density of H^- inside such clouds is calculated from mean densities of neutral hydrogen atoms and free electrons, derived from radio observations for the local region outside the large Orion-arm clouds. The filling factor of the small clouds is taken to be the same as that preserved in the structure of the Gum Nebula from before its ionization. An electron temperature of 3375 K corresponding to the local degree of ionization of the small-cloud hydrogen then leads to a mean density of negative hydrogen equal to 2×10^{13} cm^{-2} kpc^{-1}, in agreement with the observed diffuse-band intensities. (NL)

24097 AGE OF THE DRACO DWARF GALAXY. Castellani, V. (Consiglio Nazionale delle Richerche, Frascati, Italy). Mon. Not. R. Astron. Soc.; 172: No. 3, 59P-63P(Sep 1975).

By adopting low Z values, as recently confirmed by Hartwick & McClure, it is possible to show that the age of the dwarf elliptical galaxy Draco is expected to be definitely lower in comparison with the ages of galactic globular clusters like M15. The agreement with previous suggestions is reported and some evolutionary consequences are briefly discussed. (auth)

24098 KINEMATICS AND ORIENTATIONS OF PLANETARY NEBULAE. Cudworth, K. (Yerkes Observatory, Williams Bay, WI). Mon. Not. R. Astron. Soc.; 172: No. 3, 57P-58P(Sep 1975).

The kinematics of planetary nebulae are shown to be inconsistent with the hypothesis that the orientations (long axis parallel to the galactic plane) are due to compression along the direction of motion through the ambient interstellar medium. (auth)

24099 HIGH VELOCITY GAS IN THE DIRECTION OF DELTA SCO. Hicks, T. R.; Reay, N. K.; Ring, J.; Scaddan, R. J. (Imperial Coll. of Science and Tech., London). Mon. Not. R. Astron. Soc.; 172: No. 3, 53P-55P(Sep 1975).

Observations, using a scanning Fabry-Perot monochromator, of the interstellar Na (D2) line in the direction of δ Sco indicate a complex spectral structure. At least two clearly distinguished high velocity components exist, at -47.1 and -63.31 km s^{-1}, in addition to the main interstellar component of -11.8 km s^{-1}. These high velocity components, it is suggested may be associated with recently discovered areas of faint diffuse nebulosity in the vicinity of δ Sco. (auth)

24100 EXACT SOLUTION OF THE LIFSHITZ EQUATIONS GOVERNING THE GROWTH OF FLUCTUATIONS IN COSMOLOGY. Adams, P.J.; Canuto, V. (Institute for Space Studies, National Aeronautics and Space Administration, New York, New York 10025). Phys. Rev. D 12: No. 12, 3793-3799 (15 Dec 1975).

We present the exact solution of the Lifshitz equations governing the cosmological evolution of an initial fluctuation. Lifshitz results valid for $c_s^2 = 0$ and $c_s^2 = 1/3$ are extended in closed form to any equation of state of the form $p = c_s^2\epsilon$. The solutions embody all the results found previously for special cases of c_s^2. It is found that the growth of any initial fluctuation is only like t^n with $n \leq 4/3$ and hence insufficient to produce galaxies unless the initial fluctuation is very large. A possible way to produce very large initial fluctuations by modifying the equation of state by including gravitational interactions, as originally suggested by Sakharov, is also examined. It is found that a phase transition can occur at baryonic density of 1 nucleon per cubic Planck length, or equivalently at a time $t \simeq 10^{-43}$ sec. At those early times the masses

allowed by causality requirements are, however, too small to be of interest in galaxy formation. (auth)

24101 SUPERGALACTIC STUDIES. I. SUPERGALACTIC DISTRIBUTION OF THE NEAREST GALAXIES. de Vaucouleurs, G. (Department of Astronomy and McDonald Observatory, University of Texas at Austin). Astrophys. J. 202: No. 2, 319-326 (1 Dec 1975).

The supergalactic distribution of the nearest galaxies is investigated to test the nature of the Local Supercluster and to determine whether the Local Group is inside or outside its boundaries. Objectively selected samples of galaxies generally nearer than 10 Mpc are defined by (*a*) members of the Local Group, (*b*) the largest and/or brightest galaxies (mag <10, diameter $>10'$, with $V_0<+700$ km s^{-1}), (*c*) low-velocity galaxies ($V_0<+200$ km s^{-1}), (*d*) the DDO dwarfs. The great majority of these objects are distributed in a broad belt well populated in both hemispheres and inclined 14° to the supergalactic equator. This belt, including the Local Group, the Sculptor ring, the Centaurus chain, the M51, M81, M101, and IC 342 groups, and several others as well as isolated, nearby field galaxies, is a supergalactic analog to the Gould belt in galactic structure. Its north pole is at L=172°, B=+76°, and there is a small dip of about −4° indicating that the Galaxy is ~0.3 Mpc to the north of the equatorial plane of this *Local Cloud* of galaxies. The nearby intergalactic H I clouds, and in particular the Magellanic Stream, are also close to the same plane. The probability that the observed distributions could arise by chance if nearby groups and galaxies were randomly distributed is in the range $P<10^{-3}$ to $P<10^{-5}$ for the various classes of objects. It is concluded that (1) the Local Supercluster is a diaklike physical and dynamical system, and (2) the Local Group is well within the borders of the system. The alternative hypothesis that it is an appearance resulting from a random clumping accident has negligibly small probability. (auth)

24102 SUPERGALACTIC STUDIES. II. SUPERGALACTIC DISTRIBUTION OF THE NEAREST INTERGALACTIC GAS CLOUDS. de Vaucouleurs, G.; Corwin, H.G. Jr. (Department of Astronomy and McDonald Observatory, University of Texas at Austin). Astrophys. J. 202: No. 2, 327-334 (1 Dec 1975).

We confirm the report by Mathewson, Cleary, and Murray that the nearby "high velocity" H I clouds, and in particular the Magellanic Stream, are strongly concentrated toward the supergalactic plane. The observed concentration within ±30° from the supergalactic equator of 21 out of 25 clouds in the north galactic hemisphere and 27 out of 31 clouds in the south galactic hemisphere could occur by chance in less than 7 and 3 percent of random samples from a population having a statistically isotropic Poisson distribution. Since the two galactic hemispheres are substantially independent samples, the combined probability of the chance hypothesis is $P<2\times10^{-3}$. We find that actually the high-velocity clouds are not so much concentrated toward the supergalactic equator (SGE) as toward the equator of the "Local Cloud" of galaxies inclined 14° to the main supergalactic plane. Both galaxies and H I clouds define the same small circle of maximum concentration and exhibit the same standard deviation (15°) from it, demonstrating closely related space distributions. We conclude that, with the possible exception of a few of the largest and probably nearest cloud complexes (MS, AC, C), most of the high-velocity clouds are truly intergalactic and associated with the Local Group and nearer groups of galaxies. Half the population in a total sample of 115 nearby galaxies and intergalactic gas clouds is within 11° from the local equator, indicating a half-thickness of ~0.75 Mpc for the Local Cloud. Intergalactic gas clouds have already been identified near 10 of the nearest galaxies (including our Galaxy and the Magellanic Clouds), most within ~3 Mpc. The estimated space density of intergalactic gas clouds is $N\simeq20$–25 Mpc^{-3}, in approximate agreement with the densities required by the collision theory of ring galaxies. (auth)

24103 GALACTIC EVOLUTION. II. DISK GALAXIES WITH MASSIVE HALOS. Ostriker, J.P. (Princeton University Observatory); Thuan, T.X. Astrophys. J. 202: No. 2, 353-364 (1 Dec 1975).

Models of galactic evolution are computed in which matter shed by dying halo stars accumulates in a smaller, more rapidly rotating disk. The models are both simpler and more successful than one-zone (pure disk) models in that (1) the observed absence of low-metal-abundance, low-mass dwarfs is expected, not anomalous, and (2) the relative birthrate function (or IMF) need not be a strongly variable function of time in agreement with recent interpretations of the observed stellar populations and neutral hydrogen in our own and other galaxies: even a simple "Salpeter" IMF for *both* disk and halo will produce an acceptable model. The model with a halo "Salpeter" IMF and with roughly one-quarter of the mass of the disk secondary and with approximately half of the metals made in the halo seems most compatible with observations of metal abundance in low-mass stars, deuterium abundance, halo planetary nebulae, and light from Population II stars, and with arguments on the stability of the disk. Models for the spherical (halo) component of the Galaxy produced as a by-product of this investigation agree fairly well with those of Tinsley for elliptical galaxies but tend to produce somewhat smaller evolutionary corrections to the luminosity of old or cosmologically distant galaxies. (auth)

24104 PLANETARY NEBULAE IN LOCAL GROUP GALAXIES. II. IDENTIFICATIONS, POSITIONS, NUMBER, AND PRODUCTION RATE OF NEBULAE IN NGC 221. Ford, H.C.; Jenner, D.C. (Department of Astronomy, University of California, Los Angeles). Astrophys. J. 202: No. 2, 365-371 (1 Dec 1975).

We extend the identifications of planetary nebulae in NGC 221 to 21 nebulae; 19 of these are certain identifications. Radial velocity observations show that three of the 19 nebulae belong to NGC 224 and that 11 belong to NGC 221; the remaining five are probable members of NGC 221. Equatorial coordinates are presented for the nebulae and reference stars in the NGC 221 field. The coordinates have an accuracy of at least 1″0 relative to the AGK 3 and at least 0″5 relative to one another. The observed number of nebulae is corrected for the losses in the saturated image of the galaxy and for the loss of limiting magnitude in the envelope of the galaxy. With these corrections we estimate that there are 34 planetary nebulae which are brighter than our Hα limiting magnitude. The identifications of planetary nebulae provide a direct observational basis for estimating the rate at which mass returns to the interstellar medium in NGC 221. We estimate that the production rate of planetaries in NGC 221 is $\nu_{pn}\geq2.8\times10^{-3}$ nebulae yr^{-1} and that the rate of hydrogen mass loss from planetaries is $\sim6\times10^{-4}\ M_\odot$ yr^{-1}. Assuming a constant production rate of planetaries for the past 10^{10} years, at least $6\times10^6\ M_\odot$ of hydrogen has been returned to the interstellar medium in NGC 221. This is larger than the observational upper limits to the amount of neutral or ionized gas in NGC 221. The possibility of losing the gas through a Mathews-Baker galactic wind is discussed. (auth)

24105 THE STRUCTURE AND STABILITY OF SHOCK WAVES IN A MULTIPHASE INTERSTELLAR MEDIUM. II. THE EFFECT OF A MAGNETIC FIELD, THERMAL CONDUCTION, AND VISCOSITY. Mufson, S.L. (National Radio Astronomy Observatory, Green Bank, West Virginia). Astrophys. J. 202: No. 2, 372-388 (1 Dec 1975).

The effect of shock waves on a parcel of gas initially in one phase of a multiphase interstellar medium is studied. Here a model interstellar medium is considered which is heated by a constant flux of low-energy cosmic rays and which includes a magnetic field transverse to the direction of the shock and nonzero coefficients of thermal conductivity and viscosity. As in our previous study, if the shock is sufficiently strong, then gas initially in the hot, intercloud phase undergoes a phase transition and relaxes to the cold, cloud phase. A shock in the cold phase does not instigate a phase change. The stability of the gas in the nonequilibrium conditions behind a shock is investigated in the short wavelength limit. The results show that gas shocked from either the intercloud or cloud phase encounters zones of thermal instability as it moves downstream to equilibrium. Under a wide variety of initial conditions the gas traverses these zones in times long compared with the e-folding time for the instability. The numerical examples demonstrate that shocks in the intercloud gas possess a mechanism to convert intercloud gas to cloud gas and fragment this gas to form clouds and stars. In addition, they show that thermal instability in shocked gas offers one explanation of the fine structure seen in supernova remnants. (AIP)

24106 ON THE KRAMERS-KRONIG RELATIONS FOR INTERSTELLAR POLARIZATION. Martin, P.G. (David Dunlap Observatory and Scarborough College, University of Toronto). Astrophys. J. 202: No. 2, 389-392 (1 Dec 1975).

The difficulties encountered in using the Kramers-Kronig relations to predict the behavior of interstellar polarization are pointed out, while at the same time their value in an interpretive role is acknowledged. Observations of interstellar circular polarization lead to restrictions on the interstellar grain composition, and additional constraints should be possible through measurements of linear polarization in the infrared and the ultraviolet. (auth)

24107 SOME IMPLICATIONS OF 10-MICRON INTERSTELLAR POLARIZATION. Martin, P.G. (David Dunlap Observatory and Scarborough College, University of Toronto). Astrophys. J. 202: No. 2, 393-399 (1 Dec 1975).

From observations of the linear polarization at the 10 μ "silicate" feature, such as reported for the Becklin-Neugebauer source, constraints may be placed not only on the shape and degree of alignment of the interstellar grains, but also on the 10 μ band strength of the grain material itself. Preliminary analysis of the available data suggests that the band strength may be smaller than the value usually assumed for interstellar silicates by a factor 2 or 3; this would provide another clue to the origin of the grains. Independent knowledge of the band strength is also important for the prediction of the accompanying near-infrared and optical extinction, both of which are needed in the interpretation of the nature of the infrared sources. (auth)

24108 40–350 MICRON OBSERVATIONS OF GALACTIC SOURCES. Furniss, I.; Jennings, R.E.; Moorwood, A.F.M. (Department of Physics and Astronomy, University College, London). Astrophys. J. 202: No. 2, 400-406 (1 Dec 1975).

Broad-band 40–350 μ measurements are reported for 31 sources observed with a balloon-borne telescope. All but one of the sources have

been identified with galactic H II regions, of which about one-third are optically visible. The objects include W3 (three components), W49, RCW 36, RCW 38, and 24 sources lying along the galactic plane between $l^{II}=327°$ and 349°. Most of these sources have not previously been observed in the far-infrared. A contour map of the W3 region shows an emission arm extending from the main continuum component. (auth)

24109 OBSERVATIONS OF AN ISOLATED COMPACT INFRARED SOURCE IN PERSEUS. Westbrook, W.E. (George W. Downs Laboratory of Physics, California Institute of Technology); Becklin, E.E.; Merrill, K.M.; Neugebauer, G.; Schmidt, M.; Willner, S.P.; Wynn-Williams, C.G. Astrophys. J. 202: No. 2, 407-414 (1 Dec 1975).

Infrared, optical, and radio observations are described of an unusual compact infrared source discovered during the AFCRL survey. It is suggested that the object may be a planetary nebula seen at an unprecedentedly early phase in its evolution. (auth)

24110 THE ROCKET-ULTRAVIOLET SPECTRUM OF THE PLANETARY NEBULA NGC 7027. Bohlin, R.C. (Goddard Space Flight Center); Marionni, P.A.; Stecher, T.P. Astrophys. J. 202: No. 2, 415-420 (1 Dec 1975).

An ultraviolet spectrum of NGC 7027 was obtained with a rocket-borne telescope. The observed fluxes are given on an absolute basis, and upper limits are given for the strongest predicted lines which were not observed. The extinction correction was made on the basis of the observed and calculated line ratios for the hydrogenic recombination line of He II at 1640 Å to Hβ. The extinction is in agreement with ground-based determinations. When corrected for extinction, the C IV resonance line at 1549 Å is in good agreement with the intensity calculated from models, but the C III intercombination line at 1909 Å is a factor of 10 too bright. The addition of dielectronic recombination to the models sufficiently changes the C III concentration to reduce the discrepancy to a factor of 4. The abundance of carbon is assumed to 2×10^{-4} that of hydrogen. Using carbon abundances for the Sun, which are up to 3 times higher, this discrepancy disappears, and there must be attenuation in the C IV line. Since the optical depth is $\sim10^4$ at the line center, no appreciable number of absorbing grains can exist in the C IV producing region of the nebula. (auth)

24111 STRONG SCINTILLATIONS IN ASTROPHYSICS. III. THE FLUCTUATIONS IN INTENSITY. Lee, L.C.; Jokipii, J.R. (Department of Planetary Sciences, University of Arizona). Astrophys. J. 202: No. 2, 439-453 (1 Dec 1975).

We present a discussion of fluctuations in intensity due to wave propagation in a wide range of turbulent media, based on the theory developed in Paper I of this series. An asymptotic analytic solution to the fourth-moment equation is presented, and its range of validity is discussed. Various parameters characterizing the intensity fluctuations, such as scintillation index, correlation scale, etc., are expressed in terms of turbulence parameters for both Gaussian and power-law irregularity spectra and for thick and thin turbulent media. (auth)

24112 A STRONG MILLIMETER WAVE COMPONENT IN THE RADIO GALAXY 3C 111. Wills, B.J. (University of Texas Radio Astronomy Observatory, Department of Astronomy, University of Texas). Astrophys. J. Lett. 202: No. 2, L59-L62 (1 Dec 1975).

Observations of the radio galaxy 3C 111 show this source to have a very strong and very compact component at millimeter wavelengths, 3000 times more luminous than that recently found in Cen A. This component is coincident with the optical galaxy and may also be related to the X-ray source 3U 0430+37. The spectrum of the north-following, extended outer component remains power-law even at 3.3 mm wavelength. At least five spectral components of 3C 111 may be distinguished. (auth)

24113 MEASUREMENTS OF LOW-ENERGY GAMMA RADIATION FROM THE CRAB NEBULA AND FROM PULSAR NP 0532. Walraven, G.D.; Hall, R.D.; Meegan, C.A.; Coleman, P.L.; Shelton, D.H.; Haymes, R.C. (Department of Space Physics and Astronomy, Rice University, Houston, Texas). Astrophys. J. 202: No. 2, 502-510 (1 Dec 1975).

A balloon-altitude measurement of the energy spectra from the Crab Nebula and pulsar NP0532 was conducted on 1973 May 15. The measurements were conducted in the 0.056–12.110 MeV energy interval with an actively collimated scintillation counter that has a 182 cm^2 sensitive area and a 13° beam. A power law with a photon-number spectral index of 2.13 ±0.04 fits the nebular spectrum and a prolongation of the X-ray spectrum observed by others. The pulsar spectrum is also well approximated by a power law, with a number spectral index of 2.2±0.2. No statistically significant evidence for departures from these power laws was detected. (auth)

24114 THE MASS-LUMINOSITY RATIO IN THE COMA CLUSTER OF GALAXIES FROM TWO-BODY INTERACTIONS. Noonan, T.W. (Brockport State College, Brockport, New York). Astrophys. J. 202: No. 2, 551-557 (1 Dec 1975).

An analysis of galaxies in the central region of the Coma cluster with available redshifts indicates that galaxies with nearer neighbors tend to have a larger velocity dispersion. Interpretation of the effect in terms of two-body encounters indicates a mass-luminosity ratio of several hundred. (auth)

24115 CARBON MONOSULFIDE IN DUST CLOUDS AND GLOBULES. Martin, R.N.; Barrett, A.H. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology). Astrophys. J. Lett. 202: No. 2, L83-L86 (1 Dec 1975).

$C^{32}S$ has been detected in seven out of eight dust clouds searched in the $J=2\rightarrow1$ and $J=1\rightarrow0$ transitions. A search for the $J=2\rightarrow1$ $C^{34}S$ line yielded one possible detection. We derive excitation temperatures of 2.9–7.0 K and optical depths greater than 1. Using a simple model, including radiative trapping, we deduce molecular hydrogen densities greater than 10^4 cm^{-3} and CS/H_2 abundances of 10^{-8} to 10^{-9}. (auth)

24116 THE DEPLETION OF INTERSTELLAR ELEMENTS AND THE INTERACTION BETWEEN GAS AND DUST IN SPACE. Snow, T.P. Jr. (Princeton University Observatory). Astrophys. J. Lett. 202: No. 2, L87-L90 (1 Dec 1975).

Recent data obtained with *Copernicus*, combined with new results from the literature, indicate that the depletions of interstellar elements may depend on cloud density in a simple way. This is expected if the depletions are due to accretion of gas particles onto grains under presently existing conditions, but is not expected if the depletions take place during the grain formation process, before mixing into the interstellar medium. The suggestion that depletion occurs via accretion may be supported by the existence of a good correlation between depletions and first ionization potentials of the elements, since the latter quantity determines to a great extent the chemical and physical properties, and hence possibly the sticking coefficient, of each species. If the grains do not carry large positive charges, then ion-grain encounters may be important not only in creating the depletions, but also in determining ionization equilibrium, particularly if a large population of very small grains is present. (auth)

24117 INTERSTELLAR MAGNESIUM ABSORPTION IN THE DIRECTION OF FOUR UNREDDENED STARS. Boksenberg, A.; Kirkham, B.; Pettini, M. (Department of Physics and Astronomy, University College London); Bates, B.; Carson, P.P.D.; Dufton, P.L.; McKeith, C.D. Astrophys. J. Lett. 202: No. 2, L91-L95 (1 Dec 1975).

Spectral observations of the interstellar lines of Mg^+ at 2795 and 2802 Å and Mg^0 at 2852 Å have been made with a resolution of 0.1 Å, toward several stars, with an objective grating spectrograph mounted on a balloon-borne, star-stabilized platform. We discuss the analysis of the spectra of four, nearby, unreddened stars, and derive values for the interstellar Mg abundance and electron density for the gas in these directions. (auth)

24118 MOLECULAR HYDROGEN IN H II REGION TRANSITION ZONES. Hill, J.K.; Silk, J. (Department of Astronomy, University of California, Berkeley). Astrophys. J. Lett. 202: No. 2, L97-L99 (1 Dec 1975).

We demonstrate that H II H I transition zones of moderate density ($\sim$10–100 cm^{-3}) may contain column densities of molecular hydrogen of order 10^{13}–10^{15} cm^{-2}. (auth)

24119 THE REDSHIFT-DISTANCE RELATION. VIII. MAGNITUDES AND REDSHIFTS OF SOUTHERN GALAXIES IN GROUPS: A FURTHER MAPPING OF THE LOCAL VELOCITY FIELD AND AN ESTIMATE OF φ_0. Sandage, A. (Hale Observatories, Carnegie Institution of Washington, California). Astrophys. J. 202: No. 3, 563-582 (15 Dec 1975).

New redshifts and magnitudes have been obtained at the Mount Stromlo and Siding Spring Observatories for many galaxies in the Shapley-Ames catalog south of $\delta\simeq-30°$. A subset of the material—multiplets, groups, and clusters of E and S0 galaxies—is used to test again the isotropy of the Hubble expansion. Redshifts of 138 galaxies in 22 southern multiplets, groups, and clusters, and photoelectric *UBVR* magnitudes for 74 of the first few brightest galaxies in each aggregate give the following results. A) The color excess as a function of galactic latitude for southern galaxies increases less steeply toward the galactic plane than expected from galaxy counts, confirming an earlier result from northern data. The optical half-thickness is $\tau\simeq0$ for $|b^{II}|\gtrsim50°$. B) The absolute magnitude for first-ranked E galaxies is a very shallow function of richness for $N_c^{48}\gtrsim20$, but steepens for $N_c^{48}<20$. This requires the luminosity function to be nearly vertical at the bright end. C) Deviations from the redshift-magnitude (Hubble) diagram are uncorrelated with either supergalactic longitude, with Rubin-Ford-Rubin (RFR) regions, or with the apex of the Rubin-Ford proposed motion of the Local Group. Limits of less than 8 percent can be put on a possible perturbation of the local Hubble rate for the center and anticenter supergalactic hemispheres, using E groups with velocities smaller than 3000 km s^{-1}. D) A crude estimate of φ_0, found

from the upper limit of $\delta H/H_0 < 0.08(\sigma)$ for any possible velocity perturbation for the E groups in the presence of a density contrast of $\delta\rho/\rho = 3.4 \pm 0.2(\sigma)$, is $q_0 \leq 0.02 \pm 0.02$, from the idealized model of Silk. But the E groups here are generally beyond the Virgo cluster, giving this determination low weight; reanalysis of the spiral data puts an upper limit of $\delta H/H_0 = 0.40 \pm 0.09$ (σ), if the uncertain data for field spirals are adopted uncritically, giving $q_0 \leq 0.28 \pm 0.08$ (σ). These low values of q_0 agree with similar low values from five other methods summarized in the paper. (auth)

24120 THE COMPOSITE HUBBLE DIAGRAM. Lang, K.R.; Lord, S.D.; Johanson, J.M.; Savage, P.D. (Department of Physics, Tufts University). Astrophys. J. 202: No. 3, 583-590 (15 Dec 1975).

The composite Hubble diagram for 663 normal galaxies, 235 radio galaxies, and 265 quasi-stellar objects is given. The least squares solution to the Hubble diagram slope for each of the three classes of objects is compatible, within the errors, with that expected for a homogeneous, isotropic, expanding universe. If the Hubble constant $H_0 = 50$ km s^{-1} Mpc^{-1}, then $\langle M_v \rangle = -21.150$, $\langle L \rangle = 10^{43.96}$ ergs s^{-1}, and $\sigma_M = 0.887$ for normal galaxies; $\langle M_v \rangle = -23.061$, $\langle L \rangle = 10^{44.72}$ ergs s^{-1}, and $\sigma_M = 0.684$ for radio galaxies; and $\langle M_v \rangle = -25.784$, $\langle L \rangle = 10^{45.81}$ ergs s^{-1} and $\sigma_M = 1.451$ for the quasi-stellar objects. Here $\langle M_v \rangle$ denotes the mean absolute visual magnitude, $\langle L \rangle$ denotes the mean absolute optical luminosity, and σ_M denotes the dispersion in magnitude. It is shown that the uncertainty in the slope of the Hubble diagram for QSOs is comparable to that obtained for normal galaxies over a similar range in magnitude. This means that the scatter in the QSO Hubble diagram should not be used in arguments which question their cosmological nature. It is shown that the absolute optical luminosity of extragalactic objects increases with increasing redshift, and that any given object class occurs infrequently in the magnitude and redshift range of the others. These facts suggest an evolutionary sequence in which bright young QSOs evolve into older, less luminous radio galaxies, which in turn evolve into the weaker, still older normal galaxies. (auth)

24121 EMISSION-LINE GALAXIES AND QUASARS IN THE SOUTHERN HEMISPHERE. I. DESCRIPTION AND APPLICATIONS OF AN OBJECTIVE-PRISM SURVEY. Smith, M.G. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Astrophys. J. 202: No. 3, 591-595 (15 Dec 1975).

A selection of objects from the first plates of a low-dispersion, objective-prism survey for emission-line galaxies and quasars is used to illustrate the application of the survey to the following lines of research in extragalactic astronomy: (*a*) quasi-stellar objects, (*b*) Seyfert galaxies, (*c*) instabilities in galaxies produced by tidal interaction or explosive events, and (*d*) rates of star formation and the general chemical evolution of galaxies. Included in the discussion is a description of how the survey provides a new, purely optical, color-independent method for the direct isolation of bright, high-redshift QSOs with strong emission lines (Lα is often directly visible on the Schmidt-survey plates). The newly discovered objects used for illustration are (*a*) a radio-quiet QSO of redshift 2.07, (*b*) a luminous, class 2 Seyfert galaxy, (*c*) a compact blue emission-line galaxy with a jet or streamer, yet with no obvious interacting companion, and (*d*) a blue galaxy with Hβ flux 50 times that of 30 Doradus, and low metal abundances, which is undergoing a very intense burst of star formation. These objects are to be discussed in greater detail in subsequent papers in this series. (auth)

24122 SUPERGALACTIC STUDIES. III. THE SUPERGALACTIC DISTRIBUTION OF NEARBY GROUPS OF GALAXIES. de Vaucouleurs, G. (Department of Astronomy and McDonald Observatory, The University of Texas at Austin). Astrophys. J. 202: No. 3, 610-615 (15 Dec 1975).

The probability that the observed concentration of nearby groups of galaxies within 10°, 20° or 30° from the same great circle (supergalactic equator SGE) in both galactic hemispheres could arise by chance in a random (Poisson) distribution of cluster centers is less than 2×10^{-2} for the 17 nearer groups ($\Delta < 10$ Mpc) and less than 3×10^{-2} for the 46 groups in the next distance range ($10 < \Delta < 16$ Mpc on 1965 distance scale). The probability that both sets could fall by chance within 30° from the same circle with the observed frequencies is less than 5×10^{-4}. This result takes into account the effect of galactic extinction and is insensitive to the diameter assumed for the Virgo cluster. The variations of the supergalactic concentration index C as a function of magnitude and of supergalactic latitude and longitude define unequivocally the direction of the center of the Local Supercluster even when a large sector, including the Virgo cluster, is excluded from the statistics. The concentration of galaxies to the supergalactic equator is detectable at least up to ±90° away from the Virgo cluster for $m \geq 12$ and at all longitudes for $m \leq 12$. It is clear that the "supercluster effect" cannot be explained by the combined effects of galactic extinction, small-scale clustering and a hypothetical "large" Virgo cluster. (auth)

24123 SUPERGALACTIC STUDIES. IV. SYSTEMATIC ORIENTATION OF GALAXY CLOUDS RELATIVE TO THE SUPERGALACTIC PLANE. de Vaucouleurs, G. (Department of Astronomy and McDonald Observatory, The University of Texas at Austin). Astrophys. J. 202: No. 3, 616-618 (15 Dec 1975).

The major nearby clouds of galaxies tend to be elongated in directions roughly parallel to the supergalactic plane. Out of 11 clouds (or 12 including the Local Cloud, Paper I) with major axes $a > 10°$ and sufficiently elongated ($b/a < 0.8$) to give an unambiguous direction of elongation, none is inclined to the supergalactic equator by more than 35°. If the space orientations of the cloud axes were random and uncorrelated, the probability of this happening by chance is 3×10^{-5} (or 1×10^{-5} if the Local Cloud is included). In lower supergalactic latitudes ($|B| < 10°$), the average inclination of six clouds is $\langle\phi\rangle = 20°$ with $\langle b/a \rangle = 0.49$; in higher latitudes ($10° < |B| < 40°$) five clouds have $\langle\phi\rangle = 23°$ with $\langle b/a \rangle = 0.62$. Several possible mechanisms leading to this systematic orientation in a flat supercluster are noted. This effect adds greatly to the difficulty of explaining the "supercluster effect" as a random clumping accident. The combined probability that the observed distribution of objects discussed in Papers I to IV could arise by chance in the random clumping hypothesis is of the order of 10^{-12}. (auth)

24124 H II REGIONS IN DOUBLE AND INTERACTING GALAXIES. Hodge, P.W. (University of Washington). Astrophys. J. 202: No. 3, 619-627 (15 Dec 1975).

The distributions of H II regions in 14 systems of double and interacting galaxies are examined to detect any possible distortion of the gas that may have been caused by tidal interaction between the galaxies. Most systems show no significant effect; but some, especially NGC 4038–4039, show a conspicuously anomalous H II region distribution that is probably caused by tidal effects. Remarkably, other systems, such as NGC 2805–2820 and NGC 5457–5474, show a dramatic anti-effect, in the sense that the H II regions are considerably distorted on the side of the galaxy *opposite* its companion. We look statistically at Arp's hypothesis that the H II regions are more numerous and more conspicuous on the side of a galaxy facing its companion. No such systematic tendency is found, and it is concluded that this criterion is probably not a good one by which to demonstrate NGC 7320's interaction with its apparent neighbors in Stefan's Quintet/Quartet. (auth)

24125 INTERSTELLAR Na I AND Ca II ABSORPTION IN INTERCLOUD REGIONS. Hobbs, L.M. (Yerkes Observatory, University of Chicago). Astrophys. J. 202: No. 3, 628-633 (15 Dec 1975).

The weak interstellar absorption lines of Na I, Ca II, and H I formed in the intercloud medium toward eight nearly unreddened stars are analyzed. Compared with the corresponding column densities within a standard cloud, the N (Na I)/N_H ratio is smaller by a factor probably in excess of 17, while the N (Ca II)/N_H ratio is about normal. These results imply that the local intercloud medium extensively contains low-density H I regions in which (1) the temperature $T \gtrsim 2500$ K and (2) the depletion of calcium is less severe than in the clouds by a factor of 20. (auth)

24126 OBSERVATIONS OF INTERSTELLAR Na I LINES AT 3302 Å. Crutcher, R.M. (Department of Astronomy, University of Illinois). Astrophys. J. 202: No. 3, 634-637 (15 Dec 1975).

Observations have been made of the equivalent widths of the interstellar Na I λ3302 doublet toward 21 stars which have strongly saturated D-lines. Column densities of Na I have been derived, and the depletion of Na in the interstellar medium is discussed. Toward most stars Na is depleted by about a factor of 6. The distribution of line widths is found to be strongly peaked near 1 km s^{-1}, in agreement with the isothermal sound velocity at 100 K. (auth)

24127 INTERSTELLAR ABSORPTION LINES TOWARD GAMMA ARAE. Morton, D.C.; Hu, E.M. (Princeton University Observatory). Astrophys. J. 202: No. 3, 638-649 (15 Dec 1975).

The available data on interstellar absorption lines in the spectrum of γ Ara ($E_{B-V} = 0.08$) observed from the ground and with the *Copernicus* telescope have been analyzed to give column densities of various ion stages of H, C, N, O, Na, Mg, Si, P, S, Ar, Ca, Mn, and Fe. The element abundances with respect to H nuclei in H I regions are similar to the values for ζ Oph, with depletions relative to the Sun tending to increase with increasing condensation temperature. For example, toward γ Ara Fe is depleted by a factor of 50; Mg, Si, and Mn by about 10; and S, P, and N little or none. Interstellar Si IV and probably S IV appear stronger than in most other stars, but still their low ratios to Si III and S III suggest that soft X-rays and low-energy cosmic rays are not important sources of ionization. The width of the O VI lines and the absence of N V have been interpreted as evidence for a collisionally ionized region with a temperature between 3 and 7×10^5 K containing at least 4×10^{-4} of the total interstellar column density. (auth)

24128 EVIDENCE FOR ZEEMAN SPLITTING IN 1720-MHz ON LINE EMISSION. Lo, K.Y.; Walker, R.C.; Burke, B.F. (Department of Physics, Research Laboratory of Electronics,

Massachusetts Institute of Technology); Moran, J.M.; Johnston, K.J.; Ewing, M.S. Astrophys. J. 202: No. 3, 650-654 (15 Dec 1975).

A number of 1720-MHz OH maser sources have relatively simple spectra consisting of doublets with opposite senses of circular polarization. Such doublets could be due to the Zeeman splitting of the $^2\Pi_{3/2}$ F=2→1 transition. A three-station VLBU experiment was conducted to measure the spatial separation of the emitting regions of the components of opposite sense polarization. The doublets in the 1720-MHz OH spectra of W3(OH), W51, NGC 6334 (N), and NGC 7538 (N) are found to be spatially coincident to within a linear dimension of $\sim 10^{15}$ cm (10^2 AU), suggesting that they originate from the same region in space. This is taken to be strong evidence for identifying the doublets as Zeeman components. The magnetic field within the OH maser sources responsible for the observed splitting is typically a few times 10^{-3} gauss. (auth)

24129 OBSERVATIONS OF MILLIMETER-WAVE HCN IN FOUR PROTOTYPE CLOUDS. Gottlieb, C.A.; Lada, C.J.; Gottlieb, E.W.; Lilley, A.E.; Litvak, M.M. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 202: No. 3, 655-672 (15 Dec 1975).

High-quality $J=1-0$ $H^{12}CN$ and $H^{13}CN$ line profiles at 3.4 mm have been obtained in M17, NGC 2264, Ori A, and NGC 1333. Values for the ratios of the hyperfine-split intensities and the ratio of the integrated intensities of $H^{12}CN$ and $H^{13}CN$ are given. Collapsing- or expanding-sphere and turbulent-slab cloud models are used to explain the observed line brightness temperatures, the anomalous ratios of the hyperfine-split components, and the abundances of the isotopes. Doppler overlap and Doppler shifting of hyperfine-split components at 1.7 and 1.1 mm are crucial to the results of radiative transport. Comparison of calculations with the data indicates that the parts of the collapsing or the turbulent cloud responsible for observed line widths of greater than 1 or 2 km s^{-1} cannot be interacting radiatively via these Doppler effects. No such restrictions are important for the expanding sphere. Conditions of high hydrogen density and moderate HCN column density can be found that are consistent with both CS data and the terrestrial ratio of abundances $H^{12}CN/H^{13}CN$, but not with the observed $H^{13}CN$ hyperfine-split intensity ratios. An isotope ratio smaller then terrestrial by a factor of 4 or more is required. However, parameters remain sufficiently uncertain that further HCN work, especially at shorter wavelengths, is indicated. (auth)

24130 FURTHER INVESTIGATIONS OF THE CO EMISSION FROM THE NORTH AMERICA DUST CLOUD AND L1630. Milman, A.S. (University of Maryland). Astrophys. J. 202: No. 3, 673-689 (15 Dec 1975).

This paper reports further observations of the $J=1-0$ rotational lines of $^{12}C^{16}O$ and $^{13}C^{16}O$ in two dust clouds, the North America Nebula dust cloud and L1630. The observations have higher velocity resolution ($\delta v=0.25$ km s^{-1}) than had been available previously. We have already reported that unusually bright CO emission is associated with the reflection nebulae NGC 2023 and NGC 2068 in L1630. We have looked for bright CO emission from the directions of individual Hα-emission stars in L1630 and the North America cloud, but the CO emission at these places is not enhanced above that of the surrounding material. We conclude that these stars are too cool to heat the gas appreciably. The shapes of the CO profiles are determined by the large-scale motions of the gas in dust clouds. We discuss the possibility that magnetic fields in dust clouds prevent rapid dissipation of turbulent motions in these clouds. The shapes of the CO profiles observed near NGC 2023 show that the gas motions there are turbulent, rather than systematic radial motions of the gas. From the observations of the North America Nebula dust cloud, we have been able to show that not more than about 10 percent of the carbon present in the gas is in the form of CO. (auth)

24131 ANALYSIS OF THE NEBULOSITIES NEAR T TAURI USING DIGITAL COMPUTER IMAGE PROCESSING. Lorre, J.J. (Image Processing Laboratory, Jet Propulsion Laboratory). Astrophys. J. 202: No. 3, 696-717 (15 Dec 1975).

Direct plates of T Tauri taken with the 120-inch (3 m) and 36-inch (91 cm) Lick reflectors were digitized and analyzed using digital computer image processing techniques. Luminous emission protrusions extending to as far as 13′ from T Tauri in position angles 170°, 210°, and 330° are shown. These features are variable and may contain layered structure. The complex reflection nebula west of T Tauri (NGC 1555) appears to be an illuminated portion of a much larger dark nebula whose variability is due to obscuring material near the star. (auth)

24132 ON THE PRODUCTION OF POWER-LAW SPECTRA AND THE EVOLUTION OF COSMIC SYNCHROTRON SOURCES: A MODE FOR THE CRAB NEBULA. Cocke, W.J. (Steward Observatory, University of Arizona). Astrophys. J. 202: No. 3, 773-781 (15 Dec 1975).

We investigate new solutions of the energy diffusion equation for ultrarelativistic electrons undergoing Fermi acceleration. Two special cases are considered, which produce power-law electron spectra in a natural way, and which are applicable to models of expanding synchrotron sources. These are applied to the Crab Nebula, where Fermi acceleration seems necessary to provide electrons energetic enough to produce the observed nebular X-rays. Curvature radiation losses prevent their being produced in the pulsar magnetosphere. The model gives a satisfactory fit to the overall nebular spectrum and avoids certain difficulties associated with the conventional model, the most important diffulty being that the difference between the radio and X-ray spectral indices is observed to be 1.0 whereas the conventional model predicts 0.5. We predict magnetic fields of 2×10^{-4} gauss in the outer reaches of the nebula and 3×10^{-5} gauss near the pulsar, where Fermi acceleration is believed to occur, and where hydromagnetic activity is observed. We predict a cutoff in the nebular γ-ray spectrum between 1 and 10 MeV. (auth)

24133 ANOTHER EVOLUTIONARY CORRECTION TO THE LUMINOSITY OF GIANT GALAXIES. Ostriker, J.P. (Princeton University Observatory); Tremaine, S.D. Astrophys. J. Lett. 202: No. 3, L113-L117 (15 Dec 1975).

Isolated giant galaxies may accrete their dwarf companions, and those in clusters their neighbors, by the process of dynamical friction. The computed effect is of the opposite sign and similar magnitude to the luminosity change caused by normal stellar evolution. The process, which would cause an increase in ΔM_{12} (the magnitude difference between first and second brightest cluster galaxies) with time, may be visible in the tabulated data of Sandage and Hardy (1973). Cosmological investigations could compensate for the postulated effect, if fainter galaxies were used as well as first brightest cluster galaxies in the magnitude-redshift test. (auth)

24134 COMPACT H II REGIONS IN THE OPHIUCHUS AND *R* CORONAE AUSTRINAE DARK CLOUDS. Brown, R.L. (National Radio Astronomy Observatory, Edgemont Road, Charlottesville, VA 22901); Zuckerman, B. Astrophys. J. Lett. 202: No. 3, L125-L128 (15 Dec 1975).

We report the identification of six compact H II regions in the Ophiuchus dark clouds and two H II regions in the R CrA dark cloud that were detected using the NRAO interferometer at 2695 MHz. The observed sizes ($\theta \simeq 5' - 10'$) and fluxes (~10 mJy) of these sources require that their excitation be supplied by early B stars embedded within the clouds. Three of the H II regions in Ophiuchus appear to be excited by highly obscured stars that have been detected in recent 2 μ surveys of this cloud; using the radio and infrared results, we infer that the ratio of total to selective extinction $R=4.1$ in the dense regions of the cloud. Further observations suggest that the density contrast between inner and outer parts of the cloud is at least a factor of 100 and that the total visual extinction through the most dense parts of the cloud $A_v > 100$ mag. The implications of these results with regard to the interpretation of infrared, radio recombination line and molecular line observations is discussed. (auth)

24135 FORBIDDEN SULFUR II STRUCTURES IN THE CARINA NEBULA. Walborn, N.R. (Cerro Tololo Inter-American Observatory). Astrophys. J. Lett. 202: No. 3, L129-L130 (15 Dec 1975).

[S II] and [O III] interference-filter photographs of the northern part of the Carina Nebula, obtained at the prime focus of the CTIO 4-meter reflector, are presented. Many of the principal features of each are absent in the other. The most prominent feature in the light of [S II] is the curious ring associated with the radio source Carina II, which shows intricate filamentary structure. Also conspicuous are three small clouds associated with dust, one of them spiral in shape, which glow brightly in [S II] but are invisible in [O III]. (auth)

24136 RGU PHOTOMETRY OF A FIELD TO THE DIRECTION TO THE GALACTIC CENTER. Topaktas, L. (Univ. of Basel). Astron. Astrophys., Suppl. Ser.; 22: No. 2, 207-219(Nov 1975).

A galactic center field of 0.065 square degrees with 1608 stars in the Small Sagittarius Cloud has been studied photometrically in the RGU system down to a limiting magnitude of 17.2 in G. The interstellar reddening function, the density functions for different groups of stars and the luminosity functions have been determined. The reddening is caused by three interstellar clouds with distances of 725, 3160 and 5890 pc. Almost all late-type giants have been identified as "left-side" giants forming a narrow and long branch at the left side of the main-sequence of late-type dwarfs. The density functions of the late-type giants and of the main-sequence stars with 0 less than or equal to M(G) less than 2 show maxima between 1 and 2 kpc which agree well with the distance of the next inner spiral arm (–I). The density functions of the main-sequence stars too, show maxima within the limits of completeness, lying some hundred parsecs nearer than the one of the late-type giants. The natural dispersion of the absolute magnitudes of the late-type giants does not change the density function sensibly. The luminosity function for the distance intervals of 0.4 to 0.6 and of 1.0 to 2.0 kpc corresponding to the interarm region and to the distance of the

next inner spiral arm, reflect the behavior of the density functions. The values are generally higher than the ones for the solar neighborhood. (auth)

Cosmology

Refer also to abstracts 23928, 23930, 23993, 24100, 24119, 24120, 24133, and 25075.

24137 WAVE PROPAGATION IN ROTATING PLASMAS AND INFLUENCE OF THE CORIOLIS FORCE. Engels, E.; Verheest, F. (Ghent Rijksuniversiteit (Belgium)). Astrophys. Space Sci.; 37: No. 2, 427-440(Oct 1975).

When assessing the influence of the Coriolis force on wave propagation in plasmas or other dielectric media, all the equations and relevant physical quantities should be expressed in a rotating reference frame. Only then does the Coriolis force appear. However, most treatments for plasmas seem to fail in this respect because the Maxwell equations are used in their customary form, which in general is not valid in a rotating frame. A consistent approach requires the inclusion of Schiff charges and currents in the Maxwell equations. These Schiff sources are fictitious in the same way as the Coriolis force. The resulting wave equation has coefficients depending on the position and this precludes a plane wave solution, even in the slow rotation approximation where the centrifugal force may be neglected in comparison with the Coriolis force. Perturbation analysis then gives a dispersion law as if the system were not rotating. The wave electric field, however, now has a position dependent amplitude, which is not only stretched but also changed in direction compared to the previously known unperturbed not rotating solution. (NL)

24138 HOYLE'S THEORY OF THE ORIGIN OF THE SOLAR SYSTEM. Dallaporta, N.; Secco, L. (Padua Univ. (Italy). Istituto di Astronomia). Astrophys. Space Sci.; 37: No. 2, 335-364(Oct 1975).

A quantitative re-formulation of Hoyle's theory on the formation of the solar system is attempted, according to a three-dimensional scheme based on the assumption that the original magnetic field of the star is a dipole field. This allows the analytic expression for the main parameters describing the different phases of the process to be obtained. The protostar is assumed to evolve in gravitational contraction along the Hayashi track, along which, for a given value of the radius R_0 depending on the total angular momentum, matter begins to be shed at the equator as a consequence of centrifugal instability. However, owing to the geometry of the dipole field and to Hoyle's assumption that, for a star with a convective envelope, the sign of the inward magnetic pressure determined whether the magnetic lines do wind up or not, it turns out that the magnetic coupling between the star and the disk formed at the equator starts only when the radius of the contracting star has reached the value of $R_S = 4/5R_0$; and that the shedding of matter stops for a radius value R_d, depending on the strength of the magnetic field. One is thus able to calculate the total quantity of matter emitted at the solar equator and the distance reached by the rings thus formed as functions of the radius of the star, of the initial values of the magnetic field, of the total angular momentum and of the structural factors of the star. The quantitative results are discussed in order to see whether it is possible to deduce the main characteristics of the disk, from which the solar system should have originated, for reasonable values of these main parameters. (NL)

24139 DYNAMIC PHASES IN THE EVOLUTION OF A 1.25 SOLAR MASSES C-O STAR. Kovetz, A. (Tel Aviv Univ. (Israel)); Prialnik, D.; Shaviv, G. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Astrophys. Space Sci.; 37: No. 2, 463-476(Oct 1975).

The evolution of a 1.25 solar masses carbon and oxygen (equal fractions by mass) homogeneous star is followed by means of a computer code capable of dealing with dynamic evolutionary phases. After carbon ignition at the center, followed by successive shell flashes and the formation of the T-inversion, convection begins at the surface and the model evolves through a very short but strong dynamic phase (viz. a pulsation) after which it settles down to a white dwarf configuration. (NL)

24140 REMARKS ON THE LOW VALUE OBTAINED FOR THE HUBBLE CONSTANT. Jaakkola, T. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 1, 49-51(7 Jul 1975). (In French)

Some remarks are made on the basis of the data given by Sandage and Tamman, suggesting that these authors have overestimated the distances to the most luminous galaxies and obtained a value too low for the Hubble constant. (FR)

Planetary Phenomena

Refer also to abstracts 23922, 23973, 24016, and 24031.

24141 DEVELOPMENT OF THE MARE REGOLITH: SOME MODEL CONSIDERATIONS. Quaide, W.; Oberbeck, V. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Moon; 13: No. 1-3, 27-55(May 1975).

Mare regolith is fragmental debris of variable thickness that lies upon fractured bedrock. Its origin by impact comminution of primarily local basaltic rocks is widely accepted, but the consequences of such an origin are not appreciated fully. This investigation uses results obtained in an earlier Monte Carlo study by Oberbeck et al. (1973) to shed light on those consequences by evaluating regolith growth and mixing as a function of time. Results reported are for average cases and must be used with caution. The study demonstrates that regolith growth is self regulated and has the same trend and nearly the same terminal growth rates whatever the history of bombardment: rapid initial accumulation followed by diminishing rates of growth. Mixing and all other processes investigated are growth regulated. Mixing increases as growth slows, but never to the extent that the regolith is homogenized. Because the average regolith is never homogenized, products of growth regulated processes are preserved in the stratigraphy. Differences in material properties are to be expected in vertical sections of the regolith, therefore, this model is not sufficiently refined to permit prediction of all possible trends. It does indicate, however, that deeper levels contain thinner depositional units, lesser quantities of meteoritic and exotic components, and more debris derived from shallow levels in the mare basalts than material in near surface layers. Additionally, neutron fluence production is regulated by the growth process, but because rates of growth do not differ much over the last aeon, whatever the total age or early bombardment history, values of surface fluence may be similar in many areas whatever their age. (NL)

24142 STRATIFICATION IN THE LUNAR REGOLITH: A PRELIMINARY VIEW. Duke, M. B. (NASA Johnson Space Center, Houston, Texas, USA); Nagle, J. S. (Northrop Services Inc., Houston, Texas, USA). Moon; 13: No. 1-3, 143-158(May 1975).

Although the knowledge of lunar regolith stratification is incomplete, several categories of thick and thin strata have been identified. Relatively thick units average 2 to 3 cm in thickness, and appear surficially to be massive. On more detailed examination, these units can be uniformly fine-grained, can show internal trends, or can show internal variations which apparently are random. Other thick units contain soil clasts apparently reworked from underlying units. Thin laminae average approximately 1mm in thickness; lenticular distribution and composition of some thin laminae indicates they are fillets shed from adjacent rock fragments. Other dark, fine-grained, well-sorted thin laminae appear to be surficial zones, reworked by micrometeorites. Interpretations of stratigraphic succession can be strengthened by the occurrence of characteristic coarse rock fragments and the orientation of large spatter agglutinates, which are commonly found in their original depositional orientation. (NL)

24143 PIONEER 10 PLASMA ANALYZER RESULTS AT JUPITER. Wolfe, J. H. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). pp 279-296 of Magnetospheres of the Earth and Jupiter. Formisano, V. (Ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The principal scientific objectives of Pioneer 10 are to investigate the nature of the interplanetary medium beyond the orbit of Mars, including the asteroid belt, and to make direct, in situ, observations of the planet Jupiter and its environment. The successful flyby of Jupiter by Pioneer 10 achieved the latter objectives; however, the interplanetary objectives are still being pursued in the present post-encounter mission beyond Jupiter. Present estimates are that the Pioneer 10 spacecraft can be utilized for interplanetary observations to a solar radial distance of at least 20 AU. (NL)

24144 EXPLOITATION OF ANALYTICAL RESULTS IN POTASSIUM-ARGON GEOCHRONOLOGY OF VULCANITES. Donville, B. (Toulouse-3 Univ., 31 (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 281: No. 1, 13-16(7 Jul 1975). (In French)

Two kinds of argon exist in the potassic minerals of vulcanites: radiogenic argon and allochton argon. If the atmospheric pollu-

tion is to be neglected, it is possible to plot a monogenic isochrone by analysis of a single sample with different preheatings (various temperatures and times). This monogenic isochrone gives same results (true age, isotopic composition of allochton argon) as the corresponding polygenic isochrone obtained from many cogenetic samples. (FR)

24145 FROM REGOLITH TO ROCK BY SHOCK. Kieffer, S. W. (California Univ., Los Angeles (USA)). Moon; 13: No. 1-3, 301-320(May 1975).

A model for shock-lithification of terrestrial and lunar regolith is proposed. In this model it is proposed that air or an air-water mixture initially in the pores of terrestrial soil affects the behavior of the soil-air-water system under shock-loading. Shock lithified rocks found at Meteor Crater are classified as "strongly lithified" and "weakly lithified" on the basis of their strength in hand specimen; only weakly lithified rocks are found at the missile impact craters. These qualitative strength properties are related to the mechanisms of bonding in the rocks. The densities of weakly lithified samples are directly related to the pressures to which they were shock-loaded. A comparison of the petrographic textures and densities of weakly lithified samples with textures and densities of "regolith" shock-loaded to known pressures suggests that weakly lithified terrestrial samples formed at pressures well under 100kb., probably under 50 kb. If terrestrial soils are shock-loaded to pressures between 100 and 200 kb by impact events of short duration, the pore pressure due to hot air or air-water mixtures exceeds the strength of the weak lithification mechanisms and fragmentation rather than lithifications, occurs. At pressures above 200 kb, lithification can occur because the formation of glass provides a lithification mechanism which has sufficient strength to withstand the pore pressure. (NL)

24146 DISTRIBUTION, MOVEMENT, AND EVOLUTION OF THE VOLATILE ELEMENTS IN THE LUNAR REGOLITH. Gibson, E. K. Jr; (Geochemistry Branch, NASA Johnson Space Center, Houston, Texas, USA). Moon; 13: No. 1-3, 321-326(May 1975).

28 refs.

The abundances and distributions of carbon, nitrogen, and sulfur in lunar soils are reviewed. Carbon and nitrogen have a predominantly extra-lunar origin in lunar soils and breccias, while sulfur is mostly indigeneous to the Moon. The lunar processes which effect the movement, distribution, and evolution of carbon, nitrogen, and sulfur, along with the volatile alkali elements sodium, potassium, and rubidium during regolith processes are discussed. Possible mechanisms which may result in the addition to or loss from the Moon of these volatile elements are considered. (NL)

24147 PIONEER 10 OBSERVATIONS OF THE SOLAR WIND AND ITS INTERACTION WITH JUPITER: PLASMA ELECTRON RESULTS. Intriligator, D. S. (University of Southern California, Los Angeles (USA). Dept of Physics). pp 297-300 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, The Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper the plasma electron data obtained in the Jovian magnetosheath is summarized. The inbound electron data from the two extended magnetosheath traversals are of interest since they are in general agreement with the description of the Jovian magnetosheath obtained from the ion data (Wolfe et al., 1974). As in the case of the Earth's bow shock there is heating of the solar wind electrons across the Jovian bow shock. The even higher electron temperatures observed during the second magnetosheath traversal are consistent with the general contraction of the Jovian magnetosphere due to the increase in the external solar wind dynamical pressure. (NL)

24148 OBSERVATIONS IN INTERPLANETARY SPACE OF RELATIVISTIC ELECTRONS FROM JUPITER. Chenette, D. L.; Conlon, T. F.; Simpson, J. A. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). pp 301-306 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper evidence for the presence of Jovian electrons in interplanetary space as much as 1 AU inside the orbit of Jupiter is summarized. (NL)

24149 DISTORTION OF THE JOVIAN MAGNETIC FIELD R $\lesssim$ 40 R_J AS DEDUCED FROM CHARGED PARTICLE STUDIES. McKibben, R. B.; Simpson, J. A. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). pp 307-311 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper the relationship between the rotation of Jupiter's magnetic field and time variations in the intensity of ~6-30 MeV electrons observed by the University of Chicago experiment on Pioneer 10 in the outer regions of Jupiter's magnetosphere (20 ~ R ~ 100R_J) is considered. (NL)

24150 PIONEER 10 OBSERVATIONS OF THE JOVIAN MAGNETOSPHERE: PLASMA ELECTRON RESULTS. Intriligator, D. S. (University of Southern California, Los Angeles (USA). Dept. of Physics). pp 313-316 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper the plasma electron observations obtained in the Jovian magnetosphere during the inbound portion of the Pioneer 10 flyby trajectory will be discussed. These observations imply the existence of a thermal plasma in the outer Jovian magnetosphere. (NL)

24151 CHARACTERISTICS OF JOVIAN TRAPPED ELECTRONS AND PROTONS FOR R $\gtrsim$ R_J AND THEIR INTERACTION WITH Io. Simpson, J. A.; Hamilton, D. C.; McKibben, R. B.; Mogro-Campero, A.; Pyle, K. R.; Tuzzolino, A. J. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). pp 317-324 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper a brief summary of observations of the trapped particles in the inner core region of the magnetosphere made with the University of Chicago experiment on Pioneer 10 is given. (NL)

24152 OBSERVATIONS OF JOVIAN ACCELERATED PARTICLES BOTH INSIDE AND OUTSIDE THE JOVIAN MAGNETOSPHERE: RESULTS FROM THE GODDARD-U. OF NEW HAMPSHIRE EXPERIMENT ON PIONEER 10. Trainor, J. H.; McDonald, F. B.; Teegarden, B. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center); Webber, W. R.; Roelof, E. C. (New Hampshire Univ., Durham (USA)). pp 325-353 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The results to be presented here are principally from the Goddard-U. of New Hampshire cosmic ray experiment on Pioneer 10. The first part of this paper deals with measurements of the particle population inside Jupiter's magnetosphere. In the second part observations of energetic particles in interplanetary space that have escaped from Jupiter's magnetosphere are discussed. (NL)

24153 Io-ACCELERATED ELECTRONS AND IONS. Shawhan, S. D.; Goertz, C. K.; Hubbard, R. F.; Gurnett, D. A.; Joyce, G. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). pp 375-389 of Magnetospheres of the Earth and Jupiter. Formisani, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper several recent results available from Pioneer 10 are used to revise the Io sheath model. The revised model is then used to suggest an explanation for a number of Earth-based and Pioneer 10 observations and to suggest other phenomena which might be detectable with future experiments. (NL)

24154 RINGS OF SATURN. Pollack, J. B. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Space Sci. Rev.; 18: No. 1, 3-93(Oct 1975).

94 refs.

This paper reviews observations of the rings of Saturn at visual, infrared, and radio wavelengths. Critical assessments are made of attempts to derive the physical characteristics of the rings from these measurements. A discussion is also given of the origin and evolution of the rings. (NL)

24155 RADIOASTRONOMY OF JUPITER. Stannard, D. (Nuffield Radio Astronomy Labs., Jodrell Bank (UK)). pp 221-236 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Evidence for departures of the magnetic field from that of a simple dipole is discussed, and two models which have been pro-

posed to account for the observed irregularities are described. A crucial observational test of these models is provided by measurements of the centroid of the decimetric emission relative to the optical disk with the evidence appearing to favor the centered dipole model with a localized field anomaly. The Pioneer 10 magnetometer results are described and recent observations of the decimetric emission are reviewed, and some unexplained features of the radiation discussed. (NL)

24156 DENOUEMENT OF JOVIAN RADIATION BELT THEORY. Coronite, F. V. (California Univ., Los Angeles (USA). Dept. of Physics). pp 391-410 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974). 49 refs.

The paper reviews the development of models of the Jovian Van Allen belt electron fluxes. Data from Pioneer 10 is used to test the predictions of the theoretical models.

24157 MAGNETOSPHERES OF EARTH AND JUPITER AFTER PIONEER 10. Prakash, A.; Brice, N. (Cornell Univ., Ithaca, N. Y. (USA). Center for Radiophysics and Space Research). pp 411-423 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper possible reasons for the remarkable differences observed between the magnetospheres of Earth and Jupiter are pointed out and a model of Jupiter's magnetosphere is given which sheds light on the observations of the Pioneer 10 mission and gives some idea of the interesting features one should look for during the forthcoming Pioneer 11 flyby of Jupiter. (NL)

24158 THE MAGNETOSPHERES OF JUPITER AND SATURN. Scarf, F. L. (TRW Systems Group, Redondo Beach, Calif. (USA). Space Sciences Dept.). pp 433-449 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Pioneer 10 carried no specific magnetospheric plasma physics instrumentation, so that only a little more is known with certainty than was before encounter concerning the dynamics of the Jupiter magnetosphere. One important new development is that analysis of the observed field distortions strongly indicates that the significant insights of Neil Brice and his coworkers were fundamentally correct (Brice and Ioannidis, 1970; Ioannidis and Brice, 1971; Brice, 1972; Brice and McDonough, 1973). That is, it is evident that the high rotation rate of Jupiter must fling some plasma population outward to form a high-β outer magnetosphere, and it is also clear that this plasma controls the overall dynamics and configuration of the Jupiter magnetosphere. Pre-encounter analysis of the Saturn magnetosphere is much more conjectural. (NL)

24159 IS JUPITER'S MAGNETOSPHERE LIKE A PULSAR'S OR EARTH'S. Kennel, C. F.; Coroniti, F. V. (California Univ., Los Angeles (USA). Dept. of Physics). pp 451-477 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper, Jupiter's magnetosphere is treated as an astrophysicist would treat a new exotic object that has just been discovered. A variety of oversimplified theoretical models whose function is to illuminate broad areas of consistency or conflict between theory and experiment are imposed on the data. With such a procedure, it must be expected that what the models fail to explain may be fully as interesting as any experimental numbers they happen to fit. (NL)

24160 UPPER LIMITS TO JOVIAN X-RAY EMISSION FROM THE UHURU SATELLITE. Hurley, K. C. (Center d'Etude Spatiales des Rayonnements, B.P. 4057, 31-Toulouse, France). pp 241-244 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

A variety of models can be constructed to estimate the energy in Jovian precipitating electron fluxes and the resulting x-ray fluxes which reach the Earth; three models are outlined, the details concerning the assumed electron spectra, cross sections, etc. having appeared elsewhere. (NL)

24161 UPPER LIMITS FOR X-RAY EMISSION FROM JUPITER AS MEASURED FROM THE COPERNICUS SATELLITE. Vesecky, J. F. (Leicester Univ. (UK)); Culhane, J. L.; Hawkins, F. J. (University Coll., London (UK). Mullard Space Science Lab.). pp 245-251 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper upper limit x-ray fluxes from three Copernicus detectors covering the 0.6 to 7.5 keV energy range are reported. First the detectors are briefly described and the times at which observations were made are given. A portion of the observational period fortunately coincided with a period of decametric radioactivity on Jupiter and upper limit fluxes for this time are noted separately. Photon number spectra proportional to E^{-2}, E^{-3}, and E^{-4} (E = photon energy in keV) are fitted to the observed upper limit counting rates in each detector and the resulting upper limit spectra are compared with previous x-ray observations of Jupiter. Finally the upper limit x-ray fluxes are discussed in relation to magnetospheric activity on Jupiter. (NL)

24162 PHOTOCHEMISTRY OF HYDROCARBONS IN THE JOVIAN UPPER ATMOSPHERE. Prasad, S. S.; Capone, L. A.; Schneck, L. J. (Florida Univ., Gainesville (USA). Dept. of Physics and Astronomy). pp 255-268 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The recent remarkable success of Pioneer 10 has greatly expanded the arena of planetary aeronomy. New and invigorating incentives and justifications now exist for more thorough studies in Jovian upper atmospheric physics and chemistry. One important problem in this area is the problem of the photochemistry of the hydrocarbons. Apart from being interesting in its own right, knowledge of the distributions of the various hydrocarbons is needed in many other studies, too (e.g., the thermal structure). A study of the hydrocarbon photochemistry in the Jovian atmosphere is reported here. (NL)

24163 LONG TERM VARIATIONS OF THE DECIMETRIC RADIO EMISSION OF JUPITER (AND SATURN). Gerard, E. (Observatoire de Paris, Section de Meudon, 92 (France)). pp 237-239 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The Jovian total flux density at decimeter wavelengths is known to possess a short modulation due to the beaming of the synchrotron radiation of the relativistic electrons trapped in the dipole magnetic field of the planet. The maximum flux (later called I_{max}) occurs twice per rotation when the Earth is at zero magnetic declination. It has been a matter of dispute for many years to know whether I_{max} was variable over long periods of time, i.e., months and years. After more than a decade of observations it is clear that the flux density of Jupiter is variable at 21, 11, and 6 cm wavelength. (NL)

24164 COMPOSITION OF COMETARY DUST: THE CASE AGAINST SILICATES. Mendis, D. A.; Wickramasinghe, N. C. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 37: No. 2, L13-L16(Oct 1975).

It is argued that the infrared emission including 10 and 198μ features observed in recent comets is unlikely to be due to silicates. The vaporization temperature of the emitting material approximately 600K is consistent with emission by crystalline polyformaldehyde. (NL)

24165 DYNAMICAL HISTORY OF COPLANAR TWO-SATELLITE SYSTEMS. Ruskol, E. L.; Nikolajeva, E. V.; Syzdykov, A. S. (AN SSSR, Moscow). Moon; 12: No. 1, 11-18(Jan 1975).

One of the possible early states of the Earth-Moon system was a system of several large satellites around the Earth. The dynamical evolution of coplanar three-body systems is studied; a planet (Earth) and two massive satellites (proto-moons) with geocentric orbits of slightly different radii. Such configurations may arise in multiple satellite systems receding from a planet due to tidal friction. The numerical integration of the equations of motion shows that initially circular Keplerian orbits are soon transformed into disturbed elliptic orbits which are intersecting. The life-time of such a coplanar system between two probable physical collisions of satellites is roughly from one day to one year for satellite systems with radii less than 20 R(Earth), and may reach 100 yr for three-dimensional systems. This time-scale is short in comparison with the duration of the removal of

satellites due to tides raised on the planet, which is estimated as 10^6-10^8 yr for the same orbital dimensions. Therefore, the lifetime of a system of several proto-moons is mainly determined by their tidal interactions with the Earth. For conditions which we have considered, the most probable result of the evolution was coalescence of satellites as the consequence of the collisions. (NL)

24166 COMPARISON OF LUNAR ULTRAVIOLET REFLECTIVITY WITH THAT OF TERRESTRIAL ROCK SAMPLES. Carver, J. H.; Horton, B. H.; McCoy, D. G.; O'Brien, R. S.; Sandercock, E. R. (Adelaide Univ. (Australia). Dept. of Physics). Moon; 12: No. 1, 91-100(Jan 1975).

The ultraviolet and visible albedos of a number of terrestrial basalts, gabbros and anorthosites have been investigated over the wavelength range 800 A to 8000 A and compared with previously reported measurements of the lunar albedo. For most of the terrestrial samples the albedo changed only slightly between visible and middle ultraviolet wavelengths in striking contrast to the Moon where the ultraviolet albedo is about a factor of five or ten less than it is in the visible. Some of the lighter colored terrestrial anorthositic samples were however found to have albedo curves that fairly closely approximate the ultraviolet darkening of the Moon. The general shape of the lunar ultraviolet albedo may be caused by a layer of anorthositic fragments on the Moon such as have been found to be a very abundant component of the Apollo "coarse-fines." (NL)

24167 SOME ASPECTS OF THE MINOR ELEMENT CHEMISTRY OF LUNAR MARE BASALTS. Ringwood, A. E. (Australian National Univ., Canberra Research School of Earth Sciences). Moon; 12: No. 2, 127-157(Feb 1975).

79 refs.

The principal minor element (including Ti) characteristics of mare basalts which must be explained by an acceptable theory of petrogenesis are reviewed. Recent hypotheses have proposed that mare basalts formed by equilibrium partial melting of pyroxene-rich cumulates which underlay and were complementary to the anorthositic crust. These hypotheses are examined in detail and are rejected on several grounds. A new hypothesis based upon partial melting under conditions of surface or local equilibrium is proposed. It is assumed that the moon accreted from material which had ultimately formed by fractional condensation from a gas phase of appropriate composition. A disequilibrium mineral assemblage with a bulk composition similar to that of the pyroxenite source region of mare basalts as derived from experimental petrological considerations was formed. It is considered that this model is capable of explaining the principal minor element characteristics of mare basalts and is consistent with interpretations of the major element chemistry of their source region based upon experimental petrology. (NL)

24168 MEASUREMENT OF THE LUNAR NEUTRON DENSITY PROFILE. Woolum, D. S.; Burnett, D. S.; Furst, M.; Weiss, J. R. (California Inst. of Tech., Pasadena (USA). Div. of Geological Sciences). Moon; 12: No. 2, 231-250(Feb 1975).

An in situ measurement of the lunar neutron density from 20 to 400 g cm^{-2} depth below the lunar surface was made by the Apollo 17 Lunar Neutron Probe Experiment (LNPE) using particle tracks produced by the ^{10}B (n,α) ^{7}Li reaction. Both the absolute magnitude and the depth profile of the neutron density are in good agreement with theoretical calculations by Lingenfelter, Canfield, and Hampel. However, relatively small deviations between experiment and theory in the effect of Cd absorption on the neutron density and in the relative ^{149}Sm to ^{157}Gd capture rates reported previously (Russ et al., 1972) imply that the true lunar ^{157}Gd capture rate is about one half of that calculated theoretically. (NL)

24169 MODEL OF LUNAR EVOLUTION. Strangway, D. W. (Toronto Univ., Ontario (Canada)); Sharpe, H. N. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Moon; 12: No. 3, 369-397(Mar 1975).

77 refs.

There have been many models describing the evolution of the sister planet. As information from the intensive exploration by the Apollo program has accumulated, more constraints on these models have emerged. A hypothesis in which there is a present day asthenosphere, a heat flow between 24 and 32 ergs $cm^{-2}s^{-1}$ and a crust which developed early in the Moon's history by melting of the outer 100 to 200 km is specifically considered. A constraint which keeps the deep interior below the Curie point of iron for the first 1 to 1.5 b.y. so that it is able to carry the memory of an early field which magnetized the cold interior is also introduced. The magnetized mare basalts and breccias cooled in this field from above the Curie point of iron (approximately 800°C) and acquired a thermoremanent magnetization. While fully recognizing that some of these constraints are subject to other interpretations, it is nevertheless instructive to consider the thermal history that follows from such a model. It is a consequence of this model that solid body convection took place late in lunar history. This may well have contributed to the lunar center of figure and center of mass offset, to the low order terms in its gravity field, and to its disequilibrium moment of inertia differences. (NL)

24170 SHALLOW LUNAR STRUCTURE DETERMINED FROM THE PASSIVE SEISMIC EXPERIMENT. Nakamura, Y.; Dorman, J.; Duennebier, F.; Lammlein, D.; Latham, G. (Marine Science Institute, University of Texas, Galveston, Texas, USA). Moon; 13: No. 1-3, 57-66(May 1975).

Data relevant to the shallow structure of the Moon obtained at the Apollo seismic stations are compared with previously published results of the active seismic experiments. It is concluded that the lunar surface is covered by a layer of low seismic velocity ($V_p \simeq 100$ ms^{-1}), which appears to be equivalent to the lunar regolith defined previously by geological observations. This layer is underlain by a zone of distinctly high seismic velocity at all of the Apollo landing sites. The regolith thicknesses at the Apollo 11, 12, and 15 sites are estimated from the shearwave resonance to be 4.4, 3.7, and 4.4 m, respectively. These thicknesses and those determined at the other Apollo sites by the active seismic experiments appear to be correlated with the age determinations and the abundances of extra-lunar components at the sites. (NL)

24171 SOURCE AND ORIGIN OF THE EXOTIC COMPONENT AND KREEP-RICH MATERIALS ON THE MOON. Murthy, V. R. (Minnesota Univ., Minneapolis (USA)). Moon; 13: No. 1-3, 111-119(May 1975).

Trace elements concentrations in the lunar soils are inversely correlated to the grain size – i.e., the finer the grain size the higher the trace element content. These enrichments are attributed to the combined effects of comminution of local rocks and a preferential addition of the exotic component to the finer grain sizes. The exotic component appears similar to Fra Mauro materials and there is a strong correlation between the percentage of exotic component and distance from Fra Mauro site. Based on trace element characteristics, it is suggested that exotic component is finely comminuted KREEP and is dispersed on the lunar surface from the Fra Mauro and other high gamma-ray active regions in the Imbrium-Procellarum regions. The major and trace element chemistry of these materials is considered to be due to impact melting of trace-element-rich accessory phases followed by variable dilution with partial melts of the bulk solid phases of plagioclase, low Ca pyroxene and olivine. The generation of KREEP and exotic component is an impact produced local process and need not imply a global occurrence of radioactive crust on the Moon. (NL)

24172 COMPOSITIONAL EVIDENCE REGARDING THE INFLUX OF INTERPLANETARY MATERIALS ONTO THE LUNAR SURFACE. Wasson, J. T.; Boynton, W. V.; Chou, C. L. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics); Baedecker, P. A. (Geological Survey, Reston, Va. (USA)). Moon; 13: No. 1-3, 121-141(May 1975).

Siderophilic element/Ir ratios are higher in mature lunar soils from highlands sites than in those from mare sites. It is inferred that the population of materials responsible for the early intense bombardment of the Moon had high ratios, and that the population responsible for the essentially constant flux has low ratios. No group of chrondrites has siderophile/Ir ratios identical to those in the mare of highlands soils; CM chondrites are the most similar, and the CM-like materials may account for a major fraction of Earth-crossing materials during the past 3.7 b.y. Siderophile/Ir ratios may be used to determine the amount of highlands regolith in soils or breccias from the mare-highlands interface areas (Apollo 15 and 17), and to infer the time of formation of highlands breccias whose siderophiles originated in mature soils. Arguments are summarized against the viewpoint that the siderophiles in most highlands breccias originated in basin-forming projectiles. Differences in mature soil siderophile concentrations at Apollo 14 and 16 indicate a substantially greater concentration at the latter site immediately following the Imbrium event. Siderophile concentrations are used to estimate mean regolith depths at landing sites; as relative values these are more precise than estimates based on seismic or crater observations. (NL)

24173 APOLLO 17 NEUTRON STRATIGRAPHY: SEDIMENTATION AND MIXING IN THE LUNAR REGOLITH. Curtis, D. B.; Wasserburg, G. J. (California Inst. of Tech., Pasadena (USA). Div. of Geological Sciences). Moon; 13: No 1-3, 185-227(May 1975).

Shifts in the isotopic abundances of Gd and Sm in soils from the Apollo 17 deep drill stem have been measured and the neutron fluence has been calculated from these measurements. The mea-

surements show two well defined regions of nearly constant fluence: (1) a thick deep section with a very large neutron fluence, and (2) a thinner shallow region with a small fluence. This depth dependence is most plausibly described by a model of rapid accumulation in the last 100-200 m.y., the layered structure reflecting accumulations of isotopically homogeneous source material. This interpretation is compatible with a variety of other characteristics of the soils, including the spallation produced ^{126}Xe normalized to target element abundances. The uniformity of various properties of soils provides criteria for defining major stratigraphic intervals in the drill stem which differ from those identified by the Preliminary Examination Team. (NL)

24174 COSMIC RAY EXPOSURE AGES OF FEATURES AND EVENTS AT THE APOLLO LANDING SITES. Arvidson, R.; Crozaz, G.; Drozd, R. J.; Hohenberg, C. M.; Morgan, C. J. (Washington Univ., St. Louis, Mo. (USA)). Moon; 13: No. 1-3, 259-276(May 1975).

Cosmic ray exposure ages of lunar samples have been used to date surface features related to impact cratering and downslope movement of material. Only when multiple samples related to a feature have the same rare gas exposure age, or when a single sample has the same ^{81}Kr-Kr and track exposure age can a feature be considered reliably dated. Because any single lunar sample is likely to have had a complex history, assignment of ages to features based upon only one determination by any method should be avoided. Based on the above criteria, there are only five well-dated lunar features: Cone Crater (Apollo 14) 26 m.y., North Ray Crater (Apollo 16) 50 m.y., South Ray Crater (Apollo 16) 2 m. y., the emplacement of the Station 6 boulders (Apollo 17) 22 m.y., and the emplacement of the Station 7 boulder (Apollo 17) 28 m.y. Other features are tentatively dated of have limits set on their ages: Bench Crater (Apollo 12) $\leq$ 99 m.y., Baby Ray Crater (Apollo 16) $\leq$ 2 m.y., Shorty Crater (Apollo 17) $\sim$ 30 m.y., Camelot Crater (Apollo 17) $\leq$ 140 m.y., the emplacement of the Station 2 boulder 1 (Apollo 17) 45-55 m.y., and the slide which generated the light mantle (Apollo 17) $\geq$ 50 m.y. (NL)

24175 PIONEER 10: OBSERVATIONS OF ENERGETIC ELECTRONS IN THE JOVIAN ATMOSPHERE. Randall, B. A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). pp 355-373 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The University of Iowa experiment on Pioneer 10 is a simplified version of the originaaly proposed instrument. This simplification was due to the constraints specified by the National Aeronautics and Space Administration at the time of acceptance of the experiment. The reduced observational objectives of the experiment were: (a) to make an exploratory survey of the intensities, energy spectra, and angular distribution of energetic particles in the magnetosphere of Jupiter; (b) to measure the heliocentric radial gradient of the intensity of galactic cosmic rays $E_p \geq 80$ MeV (Van Allen, 1972, 1973; Thomsen, 1974); and (c) to study the occurrence, intensity, and angular distribution of solar flare particles and their propagation through the interplanetary medium at large heliocentric distances. (NL)

24176 IS JUPITER THE COSMIC RAY SOURCE IN OUR SOLAR SYSTEM. Pizzella, G. (Rome Univ. (Italy)). pp 425-432 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

This paper investigates the question of whether Jupiter contributes to the cosmic ray proton fluxes observed at the Earth surface with neutron monitors which, near the equator, respond on the average, to primary radiation of about 30 GeV protons. (NL)

24177 INERT GAS INVESTIGATIONS OF THE APOLLO 15 AND 17 LANDING SITES. Jordan, J. L. Houston, TX; Rice Univ. (1975). 151p. University Microfilms Order No. 75-22,026.

Thesis (Ph. D.).

The inert gas contents in size fractions of the following fines from the Apollo 15 site: 15071, 15501, 15511, 15421, and 15080 has been determined. In addition, the same for size fractions of fines 79221, 79241, and 79261 from depths of 0 to 2 cm, 2 to 7 cm, and 7 to 17 cm in a trench near Van Serg Crater at the Apollo 17 site was determined. The very low gas contents and lack of anticorrelation with grain diameter of 15421 suggests that these fines are undersaturated with respect to solar wind irradiation. The decrease in slope of the curves for gas concentration vs grain diameter of 15071 for successively heavier gases is interpreted to be the effects of the Rosiwal principle + comminution + agglutinate formation. Evidence for heavily irradiated (with respect to cosmic rays) zones deep within or beneath the regolith exists at both Apollo 15 and 17 landing sites. This may in part explain the "missing" cosmic ray record. Scatter between "young" and "old" age limits in ^{40}Ar vs ^{36}Ar plots exists for 15511, and the 3 trench fines from the Apollo 17 landing site. In the case of 15511 the observed ratios suggest that these may be the result of large impacts on the Apennine Front contributing material to the site where 15511 was collected. The observed $^{40}Ar/^{36}Ar$ ratios in the trench fines may be the result of excavation of materials with high $^{40}Ar/^{36}Ar$ ratios during the Van Serg event. The low apparent ^{40}K-^{40}Ar ages of the Apollo 15 fines are interpreted to be the result of addition of young ^{40}K-^{40}Ar age material (less than 1.8 by) from Autolycus and Aristillus, two large craters north of the site, to the older (3.3 by) mare materials. (Diss. Abstr. Int., B)

24178 HIGH-RESOLUTION SPECTRA OF IO'S SODIUM EMISSION. Trafton, L. (McDonald Observatory and the Astronomy Department, The University of Texas at Austin). Astrophys. J. Lett. 202: No. 2, L107-L112 (1 Dec 1975).

The shape of Io's sodium D_2 emission profile varies markedly with Io's orbital phase, and its width suggests that the sodium cloud may be expanding with velocities up to 18 km s^{-1}. This offers an explanation for at least part of the orbital phase asymmetry observed for the *D*-line emission. (auth)

24179 OBSERVATIONS OF JOVIAN ELECTRON EVENTS IN THE VICINITY OF EARTH. Krimigis, S.M.; Sarris, E.T. (Applied Physics Laboratory/The Johns Hopkins University, Laurel, Maryland 20810); Armstrong, T.P. Geophys. Res. Lett. 2: No. 12, 561-564 (Dec 1975).

A number of quiet-time enhancements in the intensity of interplanetary electrons over the range $0.22 \lesssim E \lesssim 2.5$ MeV have been observed with the JHU/APL experiment on the earth orbiting near-circular ($\sim$32 by 38 R_e) Explorer 47 (IMP-7) spacecraft during 1973 and 1974. These quiet-time increases last from $\sim$3 to $\sim$20 days and are observed both in the interplanetary medium and inside the magnetotail. The main features of the observations are as follows: (a) The increases occur during the first 200 days of 1973 and from day $\sim$20 to $\sim$230 in 1974. (b) The intensity onset is relatively slow (1 to 2 days) when compared to either solar electron events or magnetospheric electron bursts. (c) The electron energy spectrum is quite distinct from that of solar or magnetospheric electrons and is consistent with $\gamma = 1.3 \pm 0.3$ in a differential power law spectrum. (d) Significant anisotropies are present, several days after the onset of the increase. (e) Some distinct fluctuations appear in some of the intensity profiles, suggesting the presence of a modulated source. The appearance of these enhancements occurs during times when the earth could be magnetically connected to the magnetosphere of Jupiter, assuming typical solar wind velocities. Further, the energy spectrum is not unlike that observed by instrumentation on Pioneer 10 in the vicinity of Jupiter. On the basis of the above it is reasonable to suggest that the observed electrons may be of Jovian origin. The implications of these results are discussed, and it is suggested that interconnection between the interplanetary and Jovian magnetic field takes place. Using this concept, a length of the Jovian magnetotail of $\sim$4.6 AU is computed. (auth)

24180 THE LOWER IONOSPHERE OF MARS. Whitten, R.C.; Poppoff, I.G. (Space Science Division, Ames Research Center, NASA, Moffett Field, Calif. 94035). Geophys. Res. Lett. 2: No. 12, 565-566 (Dec 1975).

It is suggested that a recent observation of an apparent lower ionosphere on Mars may be due to ionization by galactic cosmic rays. (auth)

24181 OPTICAL PUMPING BY SOLAR RADIATION IN COMETS: POLARIZATION OF THE Na RESONANCE LINES. Mies, F.H. (National Bureau of Standards). Astrophys. J. 202: No. 3, 823-831 (15 Dec 1975).

At some distance from the nucleus of a comet, the rate of fluorescent scattering of solar radiation by an atom or molecule will be comparable to, or exceed, the rate of collisional relaxation. This is the condition for optical pumping. If the ground state has fine structure or hyperfine structure, then significant non-equilibrium distributions of these levels can result, and the fluorescence spectrum can deviate markedly from the laboratory spectrum. In particular, since the incident solar radiation is unidirectional, the pumping causes an *alignment* of the hyperfine magnetic sublevels along the incident axis, and observations from the Earth should exhibit an enhanced linear polarization in the Sun-comet-Earth plane. Therefore, polarization measurements can be used as a diagnostic for the presence or absence of collisional relaxation. Conditions are especially favorable for the enhanced polarization of the Na D_2 resonance line, and, at a scattering angle of 90°, detailed calculations are presented which predict a polarization of 16 percent,

and under favorable circumstances as much as 21 percent, as compared with 10.5 percent for a collisionally equilibrated Na gas. (auth)

24182 URANIAN METHANE ABUNDANCE, ROTATIONAL TEMPERATURE, AND EFFECTIVE PRESSURE FROM THE 6800 Å BAND. Bergstralh, J.T. (Space Sciences Division, Jet Propulsion Laboratory, California Institute of Technology). Astrophys. J. 202: No. 3, 832-838 (15 Dec 1975).

Measurements of the methane absorption features at 6800 Å in two spectrograms of Uranus have been analyzed on the working hypothesis that the features are the *R* branch of the $5\nu_3$ rotation-vibration overtone (Owen 1966). Internal and external consistencies in temperature calculations from the measurements give increased confidence that the band identification, and rotational quantum number assignments to band members, are correct. Parametric fitting of synthetic reflecting layer (RLM) and homogeneous scattering layer (HSL) spectra to the spectrograms was attempted. The best fit of an HSL spectrum was obtained with a temperature of 100 K and methane abundance in the range $\lesssim \eta N \lesssim 8$ km-amagat. Best results for an HSL spectrum ($\bar{\omega}_{0c} = 0.88$; $\mu = \mu_0 = 1/\sqrt{3}$) were $T = 100$ K and $0.5 \lesssim Nl \lesssim 2$ km-amagat These methane abundances, taken with recent estimates of the molecular hydrogen abundance (McKellar 1974), correspond to an average C:H ratio between 1.5 and 25 times larger than the solar ratio. Even greater enrichment of the C:H ratio may occur below the visible cloud boundary. High spectroscopic resolution of the present data permits direct measurement of the methane line halfwidth in Uranus's spectrum. The halfwidth corresponds to an effective pressure greater than 3 atm, depending on the mixture of atmospheric gases. Pressure in this range, at the methane rotational temperature $93 \lesssim T \lesssim 100$ K, is inconsistent with current Uranus atmosphere models having solar elemental abundance ratios. It is consistent with models which are considerably enriched in "heavier" constituents. (auth)

24183 AN OSCILLATING ASYMMETRY TO IO'S SODIUM EMISSION CLOUD. Trafton, L. (McDonald Observatory and University of Texas at Austin, Astronomy Department); Macy, W. Jr. Astrophys. J. Lett. 202: No. 3, L155-L158 (15 Dec 1975).

The spatial distribution of sodium emission north and south of Io was observed to have a time-dependent asymmetry correlated with Io's magnetic latitude. The spatial gradient was greatest when Jupiter's north magnetic pole pointed away from Io; this is a configuration of maximum probability of decametric emission. We invoke a hypothesis for explaining the asymmetry and use it to calculate preliminary fluxes of trapped charged particles of low energy in the vicinity. (auth)

24184 EVIDENCE THAT PITCH ANGLE SCATTERING IS AN IMPORTANT LOSS MECHANISM FOR ENERGETIC ELECTRONS IN THE INNER RADIATION BELT OF JUPITER. Fillius, W.; McIlwain, C.; Mogro-Campero, A.; Steinberg, G. (University of California, San Diego, La Jolla, California 92093). Geophys. Res. Lett. 3: No. 1, 33-36 (Jan 1976).

Analysis of data from the Pioneer 10 flyby discloses that pitch angle scattering plays an important part in determining the distribution of energetic electrons in the inner magnetosphere of Jupiter. Angular distributions measured by the UCSD Cerenkov detector reveal that redistribution takes place in pitch angle. Additionally, the radial profile of phase space density along the equator demands simultaneous particle losses. The loss rates are too high to be accounted for by synchrotron radiation loss, but are reasonably attributed to pitch angle scattering into the planetary loss cone. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 24238 and 24240.

24185 (ESRO-SP-106, pp 99-105) RECENT MEASUREMENTS WITH A SATELLITE-BORNE COOLED GERMANIUM SPECTROMETER. Part 2. Observations of Some γ-Ray Backgrounds. Nakano, G. H.; Imholf W. L.; Reagan, J. B. (Lockheed Palo Alto Research Lab., CA). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

High-resolution γ-ray measurements have been made in space for the first time with a cryogenically-cooled germanium spectrometer flown on board a spin-stabilized, polar-orbiting satellite (1972-076B) launched on October 2, 1972. γ-ray pulses with energies between 50 keV and 3 MeV have been analyzed by a 4096-channel pulse-height analyzer with fast time resolution. The spectrometer performed initially with an overall energy resolution of ~ 3.5 keV and remained operative for over 7 months, but with broader resolution. Some recent results are presented on the diffuse cosmic background below 200 keV, on the 0.511 MeV annihilation radiation from the atmosphere, and on the bremsstrahlung produced in the atmosphere by precipitating energetic electrons at high latitudes. (auth)

24186 (ESRO-SP-106, pp 137-145) NEW MODEL OF ATMOSPHERIC γ-RAYS AND ITS IMPLICATIONS FOR MEASUREMENT OF DIFFUSE COSMIC γ-RAYS FROM WITHIN THE ATMOSPHERE. Matteson, J. L. (Univ. of California, San Diego); Ling, J. C.; Peterson, L. E. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

A model describing atmospheric γ-rays in the range $0.3 \leq E \leq 10$ MeV based on the production per unit mass of air has been developed. The model is specified by an energy- and depth-dependent function, S (E,x) (photon g^{-1} s^{-1} MeV^{-1}), the source function. S (E,x) is described by four energy-dependent parameters determined empirically from fluxes measured with a 7.5 cm × 7.5 cm NaI counter over the atmospheric depth range $3.5 \leq x \leq 500$ g/cm². From S (E,x), obtained for both continuum and discrete γ-rays at $\lambda = 40°$, the depth and angle dependence of directional fluxes has been calculated. Growth-curve predictions needed to separate atmospheric from diffuse cosmic fluxes have also been determined. (auth)

24187 (ESRO-SP-106, pp 287-293) ATMOSPHERIC CHERENKOV TECHNIQUE FOR γ-RAY ASTRONOMY. Weekes, T. C. (Mt. Hopkins Observatory, Amado, AZ) Rieke, G. H. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

The sensitivities of various versions of the atmospheric Cherenkov technique are evaluated in terms of the effective energy and flux sensitivity for discrete γ-ray sources with power-law spectra. This permits the single-beam, double-beam and guard-ring configurations to be compared. These estimates are based on Rieke's calculation of the Cherenkov light distribution from an air shower initiated by a 10^{11} eV γ-ray and experimental measurements with the 10 m reflector on Mt. Hopkins, Arizona. (auth)

24188 (ESRO-SP-106, pp 295-299) OBSERVATIONS OF THE CRAB PULSAR WITH A WIDE-ANGLE ATMOSPHERIC CHERENKOV SYSTEM. Porter, N. A. (University Coll., Dublin); Delaney, T.; Weekes, T. C. Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

Two 1.5 m searchlights have been operated in coincidence at Mt. Hopkins, observing the Crab Nebula for a pulsed effect at γ-ray energies of about 5×10^{12} eV. A wide field (full value 5°) has been used to test the possibility, suggested by a previous result, that the angular distribution of Cherenkov light may be broadened by geomagnetic deflection of the shower particles. Analysis of 88,000 showers from January 1972 shows a 3.8 σ positive effect (0.66 ms pulse width) or 4.5 σ (1.3 ms pulse width) at the interpulse position. Results from 138,000 showers in February 1972, however, show only a small, nonsignificant effect, and the overall effect is only at the 3.03 σ level. Possible implications of the results are discussed. (auth)

24189 (ESRO-SP-106, pp 301-306) OBSERVATIONS OF NP0532 AT 10^{11} TO 10^{12} eV γ-RAY ENERGIES. Grindlay, J. E.; Helmken, H. F.; Weekes, T. C. (Smithsonian Astrophysical Observatory, Cambridge, MA). Nov 1974.

From ESLAB symposium on the context and status of γ-ray astronomy; Frascati, Italy (10 Jun 1974).

In context and status of γ-ray astronomy.

During the 1973–74 observing season, ~100 h of observational time was devoted exclusively to the study of pulsed 10^{11}–10^{12} eV γ-ray emission from NP 0532. The ground-based technique involves the measurement of the absolute time of arrival (to 100 μs) of night-sky air Cerenkov light pulses generated by cosmic-ray and electromagnetic air showers from the direction of the suspected source. These observations were carried out at the Mt. Hopkins Observatory, Arizona, and employed combinations involving the 10 m optical reflector and one 1.5 m mirror. Results of the observational program will be presented. (auth)

24190 AURORA. Hultqvist, B. (Kiruna Geophysical Institute, S-98101 Kiruna 1, Sweden). pp 77-111 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

For each big step that has been taken in the investigation of the aurora the complexity of the phenomenon under study has appeared to have increased rather than decreased. Still, in recent years a certain amount of coherence has developed in the knowledge of various aspects of the aurora and associated phenomena in the magnetosphere. Some of the dominating physical processes are beginning to be understood. Some of the more recent developments are reported on. Far from all physical processes will be discussed Those where new data has increased the understanding significantly are concentrated on. (NL)

24191 CALCULATION OF EXPECTED RATIOS OF ION PRODUCTION BY THE SOLAR COSMIC RAYS AT VARIOUS HEIGHTS. Dorman, L. I.; Krupitskaya, T. M. Kosm. Luchi; No. 15, 30-33(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Results of calculations of the expected ratio of the rates of ion production by cosmic rays at different altitudes are presented. The calculations were fulfilled for the following values of the exponent γ in the differential energy spectrum 2; 2.5; 3; 3.5; 4; 5 and 6 for different values of the minimum energy $E_{cp\ min} \geq 1$ MeV. (auth)

24192 FLUX OF ALBEDO X-RAY BREMSSTRAHLUNG ACCORDING TO THE STRATOSPHERE MEASUREMENTS. Novikov, A. M.; Shafer, Yu. G. Kosm. Luchi; No. 15, 34-35 (1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

As is known electron fluxes appear sporadically in the subpolar and the polar ionosphere, the bremsstrahlung of which can be recorded in the stratosphere. In order to determine the flux of these electrons, it becomes necessary to evaluate the quota of the albedo quanta from the lower hemisphere in the recorded bremsstrahlung. This evaluation is carried out. (auth)

24193 DYNAMICS OF AURORAL-PARTICLE PENETRATION IN THE MIDNIGHT SECTOR. Lazutin, L. L.; Mel'nikov, A. O. Kosm. Luchi; No. 15, 36-39(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

The connection between space-time and energetic characteristics of auroral particles precipitating into the Earth's atmosphere in the midnight sector is studied on the basis of complex ground and stratospheric measurements. Certain assumptions are made concerning the processes going on in the magnetosphere. (auth)

24194 NORTH-SOUTH ASYMMETRY OF COSMIC RAY INTENSITY. Gainova, L. E.; Gonchar, G. A.; Zusmanovich, A. G. Kosm. Luchi; No. 15, 90-95(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

New data supplement to the results of the earlier works devoted to the same subject have been obtained by the present authors. Ratios of correlation coefficients of the cosmic ray intensity for a number of stations to the intensity of line I_{5309} radiation for various latitudes are presented. Asymmetry of the isotropic and the anisotropic fluxes at the time of Forbush effects are also considered. (auth)

24195 DIURNAL DISTRIBUTION AND INTENSITY VARIATIONS OF COSMIC RAYS IN THE STRATOSPHERE ABOVE NORILSK. Dorman, L. I.; Karpov, V. P.; Palamarchuk, A. V. Kosm. Luchi; No. 15, 109-117(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

The paper deals with the problems of measuring diurnal distribution and intensity variations of cosmic rays in the stratosphere above Norilsk during Forbush decrease on December 16–30, 1971. (auth)

24196 SOME PROBLEMS OF COSMIC-RAY VARIATION STUDY FROM UNDERGROUND OBSERVATION DATA. Bishara, A. A.; Dorman, L. I. Kosm. Luchi; No. 15, 198-202(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Solar-diurnal variation is estimated in the underground for 0= 0; 45; 62°, obtained with an azymuthal five-channel telescope. It is shown that there exists an anisotropy in the North-South plane and also that the maximum intensity from the North occurs earlier by 3–6 hours than that from the South. The results of determination of the diurnal variation amplitude and the maximum intensity time are compared with the results obtained by other authors. (auth)

24197 HIGH-LATITUDE IONOSPHERIC ABSORPTION. Chivers, H. J. A. (Univ. of California, La Jolla, San Diego). Antarct. J. U. S.; 10: No. 5, 222-224(1975).

Observations of ionospheric absorption above Siple Station continued in 1974 using a solid-state riometer. Data are recorded on an eight-channel paper chart recorder with simultaneous observations of the magnetic field, magnetic micropulsations, and various very low frequency (VLF) receiving systems. This recording method makes it possible to compare phenomena observed on different channels without any uncertainty regarding the relative timing of events. (auth)

24198 F-LAYER DUCT PROPAGATION OF HYDROMAGNETIC WAVES IN THE POLAR CAP IONOSPHERE. Heacock, R. R. (Univ. of Alaska, Fairbanks). Antarct. J. U. S.; 10: No. 5, 220-221 (1975).

Difficulties with establishing the existence of a low-frequency cutoff in the range of 0.1 to 0.4 hertz for waves propagating in the F-layer duct are discussed. Evidence indicates that under some ionospheric conditions, Pi signals originating at auroral oval latitudes propagate to the poles and experience a cutoff. Wave polarizations in the H-D plane are examined. (BJG)

24199 PRECISE MEASUREMENT OF THE SEA LEVEL MUON CHARGE RATIO. Baxendale, J. M.; Hume, C. J.; Thompson, M. G. (Durham Univ., Eng.). J. Phys., G (London); 1: No. 7, 781-788(5 Sep 1975).

A precise measurement of the charge ratio of near vertical muons at sea level has been made using the Durham spectrograph. Over 2×10^6 particles traversed the apparatus and 1.3×10^6 particles were successfully momentum analyzed for 7 GeV/c $\lesssim P \lesssim$ 500 GeV/c. The charge ratio shows no evidence of sharp maxima or minima. The data suggest that the ratio has a broad maximum in the region of 30 GeV/c and this is consistent with an analysis of all previous measurements of the charge ratio. (auth)

24200 SEA LEVEL COSMIC RAY PROTON SPECTRUM AND RISING OF PROTON–AIR COLLISION CROSS SECTION FROM YEKUTIELI MODEL. Bhattacharyya, D. P.; Basu, D. (Indian Association for Cultivation of Science, Calcutta). J. Phys., G (London); 1: No. 7, L60-L62(5 Sep 1975).

The sea level proton spectrum has been calculated from the satellite data on primary cosmic ray nucleon spectrum using Yekutieli's nucleon cascade model and the spectrum agrees with the data obtained by other workers above 5 GeV/c. The interaction parameters yield the absorption cross section of p-air interaction which is in agreement with the measured EAS experimental results of Matano et al in the spectral energy range 10^6 to 10^9 GeV/c. (auth)

24201 PION PRODUCTION SPECTRA IN THE ATMOSPHERE DERIVED FROM SCALING HYPOTHESIS AND CE MODEL. Bhattacharyya, D. P. (Indian Association for Cultivation of Science, Calcutta). J. Phys., G (London); 1: No. 7, 773-780(5 Sep 1975).

The pion production spectra have been derived from the CE model and scaling hypothesis. It is found that the pion spectra derived from the primary cosmic ray nucleon spectrum using the CE model agrees well with the sea level muon spectrum if one assumes the energy dependence of pion inelasticity in the energy band 3 to 1000 GeV. The CE model fits with the experimental data better than that expected from the scaling hypothesis. (auth)

24202 ENERGY CALIBRATION OF THE SYDNEY AIR SHOWER ARRAY. Goorevich, L.; Peak, L. S. (Sydney Univ.). J. Phys., G (London); 1: No. 7, 762-772(5 Sep 1975).

The predicted properties of giant air showers are calculated using a comprehensive set of hadron interaction models. The possible existence of nuclear target effects, increasing interaction cross section and heavy primaries is considered by treating them as operators on other, more basic sets of model parameters. Comparison with the latest experimental results on large showers leads to a realistic relationship between observed muon size N_μ and the total energy of the primary particle E_o. In addition, the range of acceptable models determines the uncertainty in the $N_\mu - E_o$ conversion. The results are used to produce an integral energy spectrum from the observations of the Sydney array. (auth)

24203 FREQUENCY AND SPATIAL CORRELATION FUNCTIONS IN A FADING COMMUNICATION CHANNEL THROUGH THE IONOSPHERE. Liu, C. H.; Yeh, K. C. (Univ. of Illinois, Urbana). Radio Sci.; 10: No. 12, 1055-1061(Dec 1975).

Equations for the two-frequency two-position mutual coherence functions are derived under the usual parabolic and Markov approximations. These equations are then solved numerically. It is shown that the mutual coherence functions occur naturally in the study of pulse distortion through a random communication channel and in the investigation of signal correlations. Contour plots of correlation functions show the possibility of having equal values at two frequency separations for a given spatial separation. This behavior is explainable in terms of overlapping Fresnel zones. (auth)

24204 PHYSICAL SIGNIFICANCE OF THE CORRELATION ELLIPSE IN IONOSPHERIC DRIFT ANALYSIS. Burke, M. J. (Dept. of Communications, Ottawa). Radio Sci.; 10: No. 12, 1035-1036(Dec 1975).

It is shown that the correlation ellipse bears no relationship to the "average" shape of irregularities in the amplitude pattern formed at the ground from the interference of radio waves reflected or scattered from the ionosphere. The concept that the correlation ellipse should be related to the average shape arose because it was considered that the cross-correlation coefficient for zero delay between two fading records (with spatial separation r) was related to the average normalized amplitude of the irregularities at a displacement r from the center of the average irregularity. As shown in this paper, the cross-correlation coefficient for zero delay depends only on the mean fading period and the mean and variance of the time delays between corresponding fades. It retains its usual significance only if r is in the direction of drift. (auth)

24205 RADIATION FROM A LINE SOURCE CARRYING A TRAVELING WAVE IN A MAGNETOPLASMA. Pridmore-Brown, D. C. (Aerospace Corp., El Segundo, CA). Radio Sci.; 10: No. 12, 1063-1069(Dec 1975).

A modulated beam of charged particles is represented as an infinite line antenna carrying a current distribution traveling along it at a prescribed speed. The radiation from such an antenna is calculated theoretically, and typical patterns are presented for conditions appropriate to the ionosphere and magnetosphere. (auth)

24206 OBSERVATIONS OF SPREAD-F AT KODAIKANAL. Sastri, J. H.; Murthy, B. S. (Indian Inst. of Astrophysics, Kodaikanal, India). Indian J. Radio Space Phys.; 4: No. 2, 109-112 (Jun 1975).

A study of quarter-hourly ionograms of Kodaikanal (geomag. lat: 0.6°N; dip: 3.5°N) showed several instances when the spread-F disappears and subsequently reappears in two hrs or less during a night. Investigation of such events for a 2-yr period showed that this feature is not associated with systematic opposite changes in layer height and there does not seem to be any particular thre. hold height for the irregularities below which they cannot sustain. (auth)

24207 EFFECT OF ION DRAG ON THE PROPAGATION OF ATMOSPHERIC GRAVITY WAVES IN THE F REGION. Singh, K.; Singh, R. P. (Banaras Hindu Univ., India). Indian J. Radio Space Phys.; 4: No. 2, 113-115(Jun 1975).

The variations of fractional energy loss with azimuthal angle for different gravity wave periods have been studied. The losses are more for larger period gravity wave and they increase with altitudes. The attenuation of 30 min-wave is almost constant up to 90° azimuth and then decreases monotonically, whereas for 60 min-wave the attenuation coefficient first increases and then decreases showing a peak at 80° azimuth. (auth)

24208 ATMOSPHERIC RADIO NOISE FIELD STRENGTHS FOR THE CENTRAL AND WESTERN REGIONS OF INDIA. Ghosh, B. B.; Chakrabarty, D. K.; Malhotra, V. J. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 4: No. 2, 104-108(Jun 1975).

A comparison between the seasonal variations of thunderstorm-days, distributed regionally inside the landmass of India, with those of atmospheric radio noise field strengths (ARN-FS) measured in locations inside the corresponding regions, indicates that the two have similar trends of variations particularly in the northern and eastern regions of India. The findings have been utilized, as a basis for estimating the values of ARN-FS for the central region for which no measured values of ARN-FS are available. The same procedure has been adopted to estimate values of ARN-FS for the western region for which some limited measured values of ARN-FS have been reported. (auth)

24209 USE OF MONOSTATIC SODAR IN PROBING THE LOWER ATMOSPHERE. Singal, S. P.; Gera, B. S.; Aggarwal, S. K.; Saxena, M. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 4: No. 2, 146-156(Jun 1975).

From symposium on Earth's near space environment; New Delhi, India (18 Feb 1975).

Experiments conducted earlier with the help of a colocated acoustic sounder system had demonstrated the potential of the received back-scattered acoustic signals to give information about the thermal structure of the lower atmosphere. To overcome problems like transducer alignment, directivity, efficiency, beam drift, large transmitted signal and cost of antenna encountered with colocated systems, the earlier equipment has been converted into a monostatic system using a reflector horn as transmit-receive antenna. The necessary electronic circuit including an electronic T-R switch required for a monostatic system has been designed. The facsimile records obtained with this arrangement show the typical thermal plume structure formed on a bright sunny day and the radiation inversion structure formed on a clear windless night. Day-to-day observations give details of the continually varying atmospheric structure indicating the presence of complex phenomena in the lower atmosphere. Wave-like structures have been observed in the vertical and horizontal planes. While the horizontal wave motion is superimposed on the stratified laminar layers, has a time period of a few minutes, is discontinuous and lasts for many hours, the vertical wave motion is very regular, has a period of a fraction of a second and is short lived. The tropospheric turbulence seen by sodar as horizontal wave motion in lower atmosphere has also been observed by the microwave link and the satellite beacon experiments operating simultaneously at the National Physical Laboratory. (auth)

24210 IONOSPHERIC PHENOMENA RELATED TO 6300 A NIGHT AIRGLOW EMISSION. Rao, V. R.; Kulkarni, P. V. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 4: No. 2, 157-164(Jun 1975).

From symposium on Earth's near space environment; New Delhi, India (18 Feb 1975).

Dissociative recombinations of O_2^+ and NO^+ molecular ions with electrons are known to give rise to 6300 Å [OI] emission. From the night airglow observations made at low latitudes (17°N-32°N) at Mt. Abu, (24.6°N, 72.7°E geogr.) India, and the ionospheric observations from Delhi (29°N) and Ahmedabad (23°N), India, it is noted that the height variations of the F region are in anti-correlation with the 6300 Å intensities confirming the relation proposed earlier by D. Barbier. The behavior of 6300 Å is studied during spread F condition and it is found that the above relation holds good even during those occasions. From the scanning photometric observations, an East-West oriented tropical arc is identified and it is noted that this arc moves southwards with an approximate velocity of 200 m/sec. This southward movement is consistent with the concept of the geomagnetic control of the F region of the ionosphere and the equatorial anomaly. In addition to this southward movement, on a few occasions, East-West movement (with a velocity of 200 m/sec) in the isophotes is observed in the form of a sinusoidal wave. It is suggested that the travelling ionospheric disturbances could be the cause of such a sinusoidal manifestation in the East-West movement. (auth)

24211 EQUATORIAL ELECTROJET AND INTERPLANETARY PLASMA PARAMETERS. Kane, R. P. (Physical Research Lab. Ahmedabad, India). Indian J. Radio Space Phys.; 4: No. 2, 132-137(Jun 1975).

A comparative study of the day-to-day changes of equatorial electrojet parameters and interplanetary plasma parameters indicates that the normal noon-time electrojet weakens and counter-electrojet intensifies when positive B_x (towards sun), negative B_z (southward) and plasma density N increase and α becomes perpendicular to the garden-hose direction, even on quiet days (Ap = 0 - 7). It is suggested that interplanetary plasma leaks into the magnetosphere through the geomagnetic tail for selected orientations of the interplanetary field and causes ionospheric currents in the polar/auroral regions which may extend up to the equator. (auth)

24212 NIGHTTIME GEOMAGNETIC SOLAR FLARE EFFECT. Srivastava, B. J.; Abbas, H. (National Geophysical Research Inst., Hyderabad, India). Indian J. Radio Space Phys.; 4: No. 2, 102-103(Jun 1975).

Magnetograms of Hyderabad for 6 years and a few American magnetic observatories for selected days have been scrutinized for detection of possible solar flare effects in the night hemisphere caused by solar flares in the day hemisphere. Under calm magnetic conditions a small nighttime sfe (2-5γ) corresponding to a major daytime sfe (20-60 γ) can be identified, when specially looked for, in 10% of the cases. Nighttime sfe's do not exhibit the characteristic features of the daytime sfe's and are generally vitiated by perturbations and pulsations of the geomagnetic field. (auth)

24213 ROCKET OBSERVATION OF ELECTRON DENSITY IRREGULARITIES IN THE MIDDLE LATITUDE *E* REGION. Itoh, T.; Nakamura, M.; Nakamura, Y. (Institute of Space and Aeronautical Science, University of Tokyo, Komaba, Meguro-ku, Tokyo, Japan). Geophys. Res. Lett. 2: No. 12, 553-555 (Dec. 1975).

Electron density irregularity in the scale size of 4 to 100 m was observed in altitude between 90 and 120 km from rocket measurements over Japan. Analysis of the data makes clear that the spectral index of irregularities is 2 to 4 and that the irregularity amplitude is smaller than 5%. Strong irregularities exist at 92 to 95 km. The generation mechanism of these irregularities is explained by the theories of the cross field instability or the neutral turbulence. (auth)

24214 PULSATING AURORA IN HIGH-LATITUDE SATELLITE PHOTOGRAPHS. Siren, J.C. (Department of Applied Physics and Information Science, University of California, San Diego, La Jolla, California 92093). Geophys. Res. Lett. 2: No. 12, 557-560 (Dec 1975).

Pulsating aurora has been identified in DMSP photographs. Its unique zebra-stripe appearance is due to the interaction of the aurora pulsation period with the imaging device's raster scan period. It most commonly, but not exclusively, occurs on the equatorward edge of the auroral oval after midnight and is positively correlated with global magnetic acitivity. Pulsating aurora also occurs on the poleward leading edge of midnight sector surges. (auth)

24215 LINEAR THEORY OF EQUATORIAL SPREAD *F*. Hudson, M.K.; Kennel, C.F. (Department of Physics, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024). J. Geophys. Res. 80: No. 34, 4581-4590 (1 Dec 1975).

A fluid dispersion relation for the drift and interchange (Rayleigh–Taylor) modes in a collisional plasma forms the basis for a linear theory of equatorial spread *F*. The collisional drift mode growth rate will exceed the growth rate of the Rayleigh-Taylor mode at short perpendicular wavelengths and density gradient scale lengths, and the drift mode can grow on top side as well as on bottom side density gradients. However, below the *F* peak, where spread *F* predominates, we conclude that both the drift and the Rayleigh-Taylor modes contribute to the total spread *F* spectrum, the Rayleigh-Taylor mode dominating at long and the drift mode at short perpendicular wavelengths above the ion Larmor radius. (auth)

24216 THE SAR ARC EVENT OBSERVED DURING THE DECEMBER 1971 MAGNETIC STORM. Maier, E.J.; Chandra, S.; Brace, L. (Laboratory for Planetary Atmospheres, Goddard Space Flight Center, Greenbelt, Maryland 20771); Hoffman, J.H.; Shepherd, G.G.; Whitteker, J.H. J. Geophys. Res. 80: No. 34, 4591-4597 (1 Dec 1975).

Observations from five separate experiments on the Isis 2 spacecraft have permitted a study of the atmosphere/ionosphere during the December 16–20, 1971, magnetic storm. The data are most complete in the mid-latitude region, thus permitting a study of the SAR arc (subauroral red arc) which developed during the night of December 17–18. Ion composition and temperature, electron temperature, electron density height profiles from the spacecraft to the *F* region, and the intensity of the 6300-Å oxygen emission are all presented for the region of interest. It is found that the H^+ concentration has sharp gradients near the SAR arc and that the plasma temperature was significantly enhanced over typical nighttime values, reaching nearly 7000°K at 1400 km on the field line which intersected the arc. To facilitate interpretation of the data presented, we have also solved a system of time dependent equations for atmospheric/ionospheric composition and temperature by using boundary conditions which were selected such that the solutions were in agreement with the observations. From these solutions we are able to assess the influence of (1) the efflux of plasma from the ionosphere to the magnetosphere, (2) the decrease in $[O]/[N_2]$ at the turbopause, (3) the increase in the loss coefficient as a result of an increase in the vibrational temperature of N_2, and (4) the conduction of thermal energy into the ionosphere. (auth)

24217 MICROINSTABILITIES AND THE PRODUCTION OF SHORT-WAVELENGTH IRREGULARITIES IN THE AURORAL *F*

REGION. Ott, E.; Farley, D.T. (School of Electrical Engineering, Cornell University, Ithaca, New York 14853). J. Geophys. Res. 80: No. 34, 4599-4602 (1 Dec 1975).

The action of ion-neutral charge exchange collisions and the large E×B drifts that can exist in the auroral ionospheric *F* region lead to an ion velocity distribution which is anisotropic and can be peaked at finite v_i. Such distributions are unstable to the Post-Rosenbluth instability if the relative ion-neutral drift velocity exceeds 1.8 times the neutral thermal velocity. Such a drift velocity requires a large electric field, of the order of 50 mV/m or more, but such fields do exist at times in the auroral zone. By balancing the ion collision term in Boltzmann's equation with turbulent diffusion caused by the instability a lower bound of a few percent for the fluctuation level is obtained. In situ observations of this instability should be possible. Furthermore, the instability operates at short wavelengths (~10-20 cm), and so the irregularities should be detectable by a UHF radar directed normal or nearly normal to the magnetic field in the *F* region. Such geometry is difficult to achieve, however, and as yet there appears to be no clear radar evidence of the irregularities. (auth)

24218 PROPERTIES OF ELF ELECTROMAGNETIC WAVES IN AND ABOVE THE EARTH'S IONOSPHERE DEDUCED FROM PLASMA WAVE EXPERIMENTS ON THE OV1-17 AND OGO 6 SATELLITES. Kelley, M.C. (School of Electrical Engineering, Cornell University, Ithaca, New York 14850); Tsurutani, B.T.; Mozer, F.S. J. Geophys. Res. 80: No. 34, 4603-4611 (1 Dec 1975).

An analysis of ac electric field data obtained on board the OV1-17 satellite and ac magnetic field data obtained on board the Ogo 6 satellite has been made during the northern hemisphere spring and summer of 1969 with the purpose of studying extreme low frequency (ELF) electromagnetic waves above the earth's ionosphere. The results are in basic agreement with a number of previous ground-based and low-altitude satellite experiments in that the peak signal was observed at high latitudes outside the statistical location of the plasmapause on the day side of the earth, that ELF chorus was very often observed in conjunction with the steady ELF hiss emissions, that the winter hemisphere signal was considerably smaller than that observed in summer or in equinoctial months, and that the emission strength and region of occurrence are asymmetric about magnetic noon. Observations of such strong hiss signals outside the plasmasphere are somewhat surprising in light of Ogo 3 and Ogo 5 measurements which show steady ELF hiss to be closely confined to the plasmasphere at high altitudes during normal circumstances. The present study supports the hypothesis that hiss leaks out of the plasmasphere and refracts downward into the lower ionosphere; such a model predicts the observed summer-winter asymmetry and the poleward skewing of the ELF peak signal strength with decreasing altitude. The observation reported here that the high-latitude boundary for ELF signals in the ionosphere is very near the low-latitude boundary for long-wavelength ionospheric irregularities and, at least in the morning hours, very near the horizontal density gradient due to precipitation of magnetosheath plasma in the cusp suggests that these variations in the medium act to reflect the waves and to increase the high-latitude intensity further. The relationship between signal strength and magnetic activity shown by these data is in agreement with other in situ measurements but not with some ground-based data. It is argued, however, that the anticorrelation observed at high-latitude ground stations is due to an equatorward displacement of the peak wave intensity region with increasing magnetic activity; such an equatorward displacement is shown in our results. It is also shown that a significant component of wave electric field is parallel to the wave number k and hence that Landau resonant effects may occur at low altitudes between outer zone radiation belt particles and ELF hiss. (auth)

24219 OBSERVATIONS OF AN INTENSE FIELD-ALIGNED THERMAL ION FLOW AND ASSOCIATED INTENSE NARROW BAND ELECTRIC FIELD OSCILLATIONS. Bering[1], E.A. (Department of Physics and Space Science Laboratory, University of California, Berkeley, California 94720); Kelley, M.C.; Mozer, F.S. J. Geophys. Res. 80: No. 34, 4612-4620 (1 Dec 1975).

An intense downward field-aligned thermal ion flow and intense narrow band waves with frequencies just below the local ion gyrofrequency have been observed at the equatorward edge of an auroral arc. The magnitude and direction of the field-aligned current required by the measured dc electric field pattern are consistent with the ion flow measurements and with a differential drift between ions and electrons of 10-20 km/s. Such a drift is sufficient to destabilize the electrostatic ion cyclotron wave which has a narrow frequency spectrum near and above the gyrofrequency in the plasma reference frame. The narrow bandwidth of the observed electric field oscillations is in agreement with this mode, as is the frequency range which is shown to be consistent with a Doppler shift due to the relative velocity between the plasma and rocket. A second explanation for the observed ion flow involving saturation of the ion cyclotron instability by extreme heating of the plasma ions in a region above the rocket has been examined and also found to be consistent with the measurements. In this model the observed ion flow was due to a thermal expansion of the hot spot. Such heating would energize O^+ ions sufficiently that they could escape the gravitational field and could hence act as a source for energetic oxygen observed in the inner magnetosphere. (auth)

24220 IMPROVED CALCULATIONS OF ELECTRON DENSITIES BETWEEN 110 AND 300 km DERIVED FROM SOLAR EUV FLUXES OF AUGUST 23, 1972. Heroux, L.; Cohen, M.; Higgins, J.E. (Air Force Cambridge Research Laboratories (AFSC), Hanscom Air Force Base, Bedford, Massachusetts 01731). J. Geophys. Res. 80: No. 34, 4732-4734 (1 Dec 1975).

The electron densities previously calculated by Heroux et al. (1974) have been recalculated by using a new set of reaction rate coefficients and the same solar fluxes of August 23, 1972. In comparison with the previously calculated densities that were consistently about 30% less than the ionosonde densities the recalculated densities become greater than the ionosonde densities by 30% at altitudes above 200 km. The overall agreement of ±30% between the recalculated and ionosonde values of densities indicates that the solar EUV fluxes measured on this date are compatible with the experimental values of ionospheric electron densities measured on the same date. (auth)

24221 PARTIAL REFLECTIONS: A SOURCE OF WEAK VHF EQUATORIAL SPREAD *F* ECHOES. Balsley, B.B. (Aeronomy Laboratory, NOAA Environmental Research Laboratories, Boulder, Colorado 80302); Farley, D.T. J. Geophys. Res. 80: No. 34, 4735-4737 (1 Dec 1975).

Calculations show that weak equatorial spread *F* observed at VHF could be caused by partial reflections from regions containing sharp electron density gradients. Gradients inferred from rocket and satellite data are sufficient to return signals more than an order of magnitude stronger than incoherent scatter from the same region. Data showing that the echoing regions drift with the ambient ionization and occur only in regions of strong density gradients are also consistent with this hypothesis. (auth)

24222 ELECTROMAGNETIC WAVE PROPAGATION OVER AN INHOMOGENEOUS FLAT EARTH (TWO-DIMENSIONAL INTEGRAL EQUATION FORMULATION). de Jong, G. (Delft Univ. of Tech., Netherlands). Radio Sci.; 10: No. 11, 925-933(Nov 1975).

With the aid of a two-dimensional integral equation formulation, the ground wave propagation of electromagnetic waves transmitted by a vertical electric dipole over an inhomogeneous flat earth is investigated. For the configuration in which a ground wave is propagating across an "island" on a flat earth, the modulus and argument of the attenuation function have been computed. The results for the two-dimensional treatment are significantly more accurate in detail than the calculations using a one-dimensional integral equation. (auth)

24223 USE OF ATMOSPHERIC EMISSION TO ESTIMATE REFRACTIVE ERRORS IN A NON-HORIZONTALLY STRATIFIED TROPOSPHERE. Gallop, M. A. Jr.; Telford, L. E. (Air Force Cambridge Research Labs., Hanscom AFB, MA). Radio Sci.; 10: No. 11, 935-945(Nov 1975).

Tropospheric refraction introduces errors into radar and radio communication systems by causing radio waves to travel along a curved path and at a speed which changes with position. Common error correction techniques, such as making estimates of refractive effects from surface refractivity, rely implicitly on the assumption that the troposphere is horizintally stratified. This study demonstrates that such an assumption may be unwarranted especially at elevation angles below 10^0, and that such reliance can lead to substantial errors. The end product of this research is a system which employs atmospheric emission measurements in addition to surface refractivity to estimate refractive bending and range error. This approach relies on the similar dependence of refraction and emission on atmospheric parameters to account for nonhorizontal stratification. Performance results establish that such a system need employ no more than one radiometer channel to provide potential error reduction of more than 40 percent over conventional approaches, along with a potentially automated, real-time operational capability. (auth)

24224 VLF PROPAGATION IN THE MAGNETOSPHERE DURING SUNRISE AND SUNSET HOURS. Walter, F. (Instituto Tecnologico de Aeronautica, Sao Paulo, Brazil); Scarabucci, R. R. Radio Sci.; 10: No. 11, 965-971(Nov 1975).

Whistlers observed on records of the OGO-4 satellite during the sunset/sunrise hours show evidence of both the proresonance (PR) and prolongitudinal (PL) mode of propagation. By tracing rays in a model magnetosphere suitable for these hours, the whistlers observed on these records are reproduced. The upper cutoff frequency presented in the walking trace whistlers appears naturally as a consequence of the inclusion of latitudinal gradients in the electron density model. A new whistler trace is predicted which appears as a consequence of the transition from the PR to the PL mode of propagation. (auth)

24225 COHERENCE PROPERTIES OF WIDEBAND SATELLITE SIGNALS CAUSED BY IONOSPHERIC SCINTILLATION. Rufenach, C. L. (National Oceanic and Atmospheric Administration, Boulder, CO). Radio Sci.; 10: No. 11, 973-977(Nov 1975).

Radio scintillation on satellite signals caused by small-scale irregularities in F-region ionospheric electron density can be an important limitation on earth-satellite communication and navigation systems. Scintillation imposes distortion in both amplitude and phase on wideband signals. In the present work, the shallow-modulated phase screen theory is developed in terms of coherence bandwidth including a model based on a turbulent-like power-law description of the irregularities. The model results usually show a greater coherence bandwidth in the signal phase than in the signal amplitude. Therefore, systems that require phase coherence over a large bandwidth should be less affected than those requiring amplitude coherence. (auth)

24226 PROPAGATION IN RANDOM MEDIA WITH STATIONARY TEMPORAL FLUCTUATIONS. Gardner, C. S.; Kavala, F.; Pionus, M. A. (Northwestern Univ., Evanston, IL). Radio Sci.; 10: No. 11, 979-988(Nov 1975).

Born's method is applied to the time-dependent wave equation. Exact solutions, valid for all wavelengths, are obtained for the first-order perturbation terms for monochromatic plane and spherical waves propagating in random media with stationary temporal fluctuations. It is shown that the temporal fluctuations of the medium can be neglected if the temporal frequencies of the fluctuations are much less than the frequency of the propagating wave and if the propagation time from the transmitter to receiver is much less than the coherence time of the medium. In the atmosphere for the case where (λ_0^3/l_0^4) L much less than 1, where l_0 is the inner scale of turbulence, log-amplitude and phase convariance functions were calculated for the polarized and depolarized fluctuations of plane waves propagating in slightly different directions. Numerical evaluations revealed that the polarized log-amplitude fluctuations decorrelate for angular separations on the order of $\tan^{-1}$ [lambda$_0$/L)/sup $\frac{1}{2}$/] while phase fluctuations decorrelate for angular separations on the order of $\tan^{-1}$ (L_0/L), where L_0 is the outer scale of turbulence. (auth)

24227 EFFECTIVE WAVE TILT AND SURFACE IMPEDANCE OVER A LATERALLY INHOMOGENEOUS TWO-LAYER EARTH. Hughes, W. J.; Wait, J. R. (Univ. of Colorado, Boulder). Radio Sci.; 10: No. 11, 1001-1008(Nov 1975).

Using a perturbation method, the effect of a simple two-dimensional model on the electromagnetic fields at the surface of the Earth is considered for a postulated downcoming plane wave. The calculated change in the surface impedance and wave tilt due to lateral inhomogeneities is examined. It is found that the magnetic wave tilt (H/sub z//H/sub x/) is most seriously affected by such anomalies. This may have important consequences on electromagnetic probing of nonuniform portions of the Earth's crust. (auth)

24228 STRATOSPHERIC OZONE: AN INTRODUCTION TO ITS STUDY. Nicolet, M. (Pennsylvania State Univ., University Park). Rev. Geophys. Space Phys.; 13: No. 5, 593-636(Nov 1975).

An analysis is made of the various reactions in which ozone and atomic oxygen are involved in the stratosphere. At the present time, hydrogen, nitrogen, and chlorine compounds in the ranges parts per million, parts per billion, and parts per trillion may have significant chemical effects. In the upper stratosphere, above the ozone peak, where there is no strong departure from photochemical equilibrium conditions, the action of hydroxyl and hydroperoxyl radicals of nitrogen dioxide and chlorine monoxide on atomic oxygen and of atomic chlorine on ozone can be introduced. A precise determination of their exact effects requires knowledge of the vertical distribution of the H_2O, CH_4, and H_2 dissociation by reaction of these molecules with electronically excited oxygen atom $O(^1D)$; the ratio of the OH and HO_2 concentrations and their absolute values, which depend on insufficiently known rate coefficients; the various origins of nitric oxide production, with their vertical distributions related to latitude and season; and the various sources giving different chlorine compounds that may be dissociated in the stratosphere. In the lower stratosphere, below the ozone peak, there is no important photochemical production of O_3, but there exist various possibilities of transport. The predictability of the action of chemical reactions depends strongly on important interactions between OH and HO_2 radicals with CO and NO, respectively, which affect the ratio $n(OH)/n(HO_2)$ at the tropopause level; between OH and NO_2, which lead to the formation of nitric acid with its downward transport toward the troposphere; between NO and HO_2, which lead to NO_2 and its subsequent photodissociation; between ClO and NO, which also lead to NO_2 and become more important than the reaction of ClO with O; and between Cl and various molecules, such as CH_4 and H_2, which lead to HCl with its downward transportation toward the troposphere. (auth)

24229 GLOBAL OZONE BALANCE IN THE NATURAL STRATOSPHERE. Johnston, H. S. (Univ. of California, Berkeley). Rev. Geophys. Space Phys.; 13: No. 5, 637-649(Nov 1975).

The method of instantaneous rates is a three-dimensional model that takes the observed distribution of atmospheric species and temperature as input data. The distribution of radiation over wavelength, photochemical rate constants, and reaction rates are evaluated in each cell of the three-dimensional grid. For certain problems of restricted scope, definite answers can be given by this approach. For example, it is shown that the Chapman reactions and air motions are insufficient to give a global ozone balance; these factors account for only about 20 percent of the ozone produced below 45 km. There must be other photochemical or chemical reactions that destroy natural stratospheric ozone. The water reactions (H, HO, and HOO radicals) balance about 10 percent of the ozone produced below 45 km. Recently observed concentrations of nitrogen dioxide at up to 36-km elevations are close to those required to destroy the remaining 70 percent of naturally produced ozone. Until enough measurements are made to characterize the vertical, latitudinal, and seasonal distribution of nitrogen dioxide, it will not be known whether yet other substances (such as chlorine, bromine, and metallic oxide particles) play a significant (10 percent or more) role in the natural ozone balance. (auth)

24230 SOURCES OF STRATOSPHERIC GASEOUS CHLORINE. Ryan, J. A.; Mukherjee, N. R. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). Rev. Geophys. Space Phys.; 13: No. 5, 650-658(Nov 1975).

Interest in atmospheric gaseous chlorine (GCl) has been generated by its increasing anthropogenic introduction coupled with its reactivity with ozone. Present and anticipated future sources of GCl are described and an estimate of their stratospheric source strength is derived. The stratospheric sources are transport of tropospheric GCl across the tropopause, direct stratospheric introduction by major volcanic eruptions, and anthropogenic emissions in the stratosphere. The mean source strengths are estimated to be, respectively, 4×10^{10}, 1×10^{11}, and 5×10^9 g GCl yr^{-1}, the last figure representing a projection of anthropogenic emissions to include 50 space shuttle flights per year. Whereas the first source introduces GCl only at the base of the stratosphere, the other two can supply GCl directly to altitudes up to approximately 50 km. The dominant, volcanic, source is highly variable, it being estimated that as much as 3×10^{13} g GCl can enter the stratosphere from a single eruption. Although major volcanic eruptions are indicated to be the dominant source, few "hard" data are currently available. (auth)

24231 GEOMAGNETIC SECULAR VARIATION OVER THE PAST 5 m.y. McElhinny, M. W.; Merrill, R. T. (Australian National Univ., Canberra). Rev. Geophys. Space Phys.; 13: No. 5, 687-708(Nov 1975).

The study of the geomagnetic secular variation in prearcheological times is based upon investigations of the angular dispersion of paleomagnetic results and its variation with latitude. The westward drift of the geomagnetic field observed in historic times and apparently confirmed by archeomagnetic data back 1000 years or more suggests the way in which the present geomagnetic field may be analyzed for comparison with paleomagnetic results. Generalized models of paleosecular variation suppose that the angular dispersion arises from two contributions, one due to variations in the dipole field (dipole wobble) and one due to variations in the nondipole field. Attempts at distinguishing between these two contributions are inherently nonunique. To overcome the nonuniqueness problem, we have proposed a model for paleosecular variation (model M) that fits both the paleomagnetic data and the variation expected from analysis of the present field and that is also compatible with current theories of the origin of secular variation. This results in an average dipole wobble of 9^0 over the past 5 m.y. The best fit to the nondipole dispersion then arises from a combination of two mechanisms for the origin of secular variation. The major contribution arises from a nondipole field that originates from some sort of interaction with the main poloidal field, probably akin to Hide's magnetohydrodynamic wave mechanism. The secondary contribution, about two-thirds the magnitude, arises from a fixed field whose intensity is independent of latitude compatible with Bullard's mechanism of fluid eddies interacting with the toroidal field near the core-mantle boundary. The two types of nondipole field are compatible with Yukutake's subdivision into drifting and standing parts, respectively, and provide a possible physical basis for his analysis. During a polarity transition the standing part of the nondipole field should predominate. (auth)

24232 PRECIPITATION OF PARTICLES AT LOW AND MIDDLE LATITUDES. Paulikas, G. A. (Aerospace Corp., El Segundo, CA). Rev. Geophys. Space Phys.; 13: No. 5, 709-734(Nov 1975).

The phenomenology and aeronomic effects of charged particle precipitation at middle and low latitudes are reviewed. This paper

includes discussions of the behavior of quasi-trapped electrons observed at middle and low latitudes, discussions of the precipitation of protons from the ring current into the low-latitude atmosphere, and a summary of the effects of the South Atlantic magnetic anomaly on charged particles trapped at low altitudes. A brief summary and review of controversial observations of charged particle fluxes at low altitudes is also included. (auth)

24233 ROCKET-BORNE MEASUREMENTS OF AURORAL ELECTRONS. Boyd, J. S. (Rice Univ., Houston, TX). Rev. Geophys. Space Phys.; 13: No. 5, 735-741(Nov 1975).

Rocket measurements of the pitch angle and energy distributions of precipitated electrons in the 1- to 20-keV range show a consistent and relatively simple pattern. Features such as "monoenergetic peaks" and pitch angle distributions showing intense field-aligned components, rather than being anomalous, are characteristic of bright well-defined auroral forms. Presently available observations do not allow the identification of specific acceleration mechanisms, although they are consistent with several. (auth)

Effects of Nuclear Detonations

24234 (LA-6068-MS) GEOMAGNETIC RADIOFLASH UNFOLD (GRUF). Malik, J. S. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-eng-36. 4p. Dep. NTIS $4.50.

A method of inverting the geomagnetic component of the radioflash signal from a nuclear explosion to obtain the gamma-ray time history was proposed by E. D. Dracott of the Atomic Weapons Research Establishment. A simplified development of an elaboration by B. R. Suydam has been programmed for small calculators in a form suitable for interim field analysis of such data. The development of the program is contained in the report. (auth)

Magnetospheric Phenomena

Refer also to abstracts 23964, 24059, 24064, 24080, 24205, 24211, 24216, 24218, and 24232.

24235 IMPACT OF INTERPLANETARY SHOCKS ON THE MAGNETOSPHERE. Park, C. G. (Stanford Univ., CA). Antarct. J. U. S.; 10: No. 5, 216-217(1975).

The technique of using ground-based whistlers to monitor rapid changes in magnetospheric magnetic field strength and the resulting induced electric fields is discussed. This technique is useful in studying the magnetospheric response to interplanetary shocks produced by solar flares. (BJG)

24236 QUIET-TIME CIRCULATION OF THE MAGNETOSPHERIC PLASMA. Carpenter, D. L.; Seely, N. (Stanford Univ., CA). Antarct. J. U. S.; 10: No. 5, 217-218(1975).

A "dynamo" process involving motion of neutral air across the earth's magnetic field lines is believed to cause plasma motions in the magnetosphere during quiet times. Solar heating and solar and lunar gravitation influence this process. Whistlers which act as natural probes of the magnetospheric field lines are used to study this phenomena. (BJG)

24237 Pc-1 MICROPULSATIONS AT SIPLE STATION. Arnoldy, R. L. (Univ. of New Hampshire, Durham); Lewis, P. B.; Cahill, L. J. Jr.; Taylor, W. L. Antarct. J. U. S.; 10: No. 5, 219-220(1975).

Micropulsation data is analyzed for use in statistical and correlative studies. Spectrograms of Pc-1 events reveal filamentary structure and their long-lasting nature. (BJG)

24238 WHISTLER-MODE VLF PROPAGATION MEASUREMENTS AT SIPLE STATION. Burtt, G. J. (Physics and Engineering Lab., Lower Hutt, New Zealand). Antarct. J. U. S.; 10: No. 5, 221-222(1975).

Very low frequency radio signals in the whistler mode transmitted through the magnetosphere ordinarily experience a doppler frequency shift due to continuous changes in the effective electrical path length. Observations reveal a large number of whistler-mode activity periods and some pronounced diurnal patterns. (BJG)

24239 MIDLATITUDE OPTICAL OBSERVATIONS FROM SIPLE STATION, ANTARCTICA, AND ROBERVAL, QUEBEC. Mende, S. B. (Lockheed Palo Alto Research Labs., Palo Alto, CA). Antarct. J. U. S.; 10: No. 5, 224(1975).

24240 AURORAS AT THE SOUTH POLE. Akasofu, S. I. (Univ. of Alaska, College). Antarct. J. U. S.; 10: No. 5, 225-226 (1975).

The north–south component of the interplanetary magnetic field affects magnetospheric processes. The size of the auroral oval is shown to be partially controlled by this component. (BJG)

24241 HEIGHT DISTRIBUTION OF GEOMAGNETIC FIELD. Nikitin, V. F.; El'tekov, V. A. Kosm. Luchi; No. 15, 13-14 (1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Calculations of the lines of equal magnetic field intensity B are made for different levels, which makes it possible to obtain the density distribution of the charged particles flux within the radiation belts, the asymptotic angles of high energy particles entry, and to carry out calculations of cosmic ray intensity variation associated with changes in the cutoff rigidities. (auth)

24242 DETECTION OF PARTICLE OSCILLATION PERIODS IN THE RADIATION BELTS FROM COSMOS-137 DATA. Golynskaya, R. M.; Belen'kaya, B. N.; Skorokhod, E. P.; Savun, O. I. Kosm. Luchi; No. 15, 15-18(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Temporal variations of the proton and the electron intensities in the radiation belts are discussed according to the data obtained with the «Kosmos-137» satellite. (auth)

24243 SECONDARY INTERACTIONS OF SHOCK WAVES AND THEIR EFFECT ON DEVELOPMENT OF GEOMAGNETIC STORMS WITH SUDDEN COMMENCEMENT. Grib, S. A. Kosm. Luchi; No. 15, 103-108(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Interaction of a shock wave propagating in the solar wind with a head shock wave of the magnetosphere is considered in the paper. Having passed through the front of the head shock wave and through the magnetopause the travelling wave calls forth a geomagnetic storm sudden commencement. This wave is reflected from the magnetosphere boundary as a shock wave which is propagating towards the rear of the head wave front. After an interaction with it has taken place a rarefaction wave will propagate over the transition area. The importance of the reflected waves for the transfer of information from the rear towards the magnetopause and backwards is emphasized. These waves may have an influence upon the development of a geomagnetic storm, namely upon a drop in the geomagnetic field level while there is an intensively disturbed plasma flow. (auth)

24244 SOLAR COSMIC RAY DIFFUSION INTO POLAR MAGNETOSPHERE. Medvedev, M. Yu.; Smirnov, V. S. Kosm. Luchi; No. 15, 19-23(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

Calculations are carried out which allow to conclude that areas of three types exist in the resolution region differing from each other in the nature of particle intrusion. (auth)

24245 PROGRAM FOR CONNECTION COEFFICIENT CALCULATION FROM EXPERIMENTAL DATA OF LATITUDE EXPEDITIONS. Pimenov, I. A.; Satsuk, V. V. Kosm. Luchi; No. 15, 130-132(1975). (In Russian)

From All-Union conference on cosmic ray physics; Moscow, USSR (26 Oct 1970).

An algorithm and a program are described for calculations of polar coupling coefficients based on the experimental data pertaining to geomagnetic effects of cosmic rays. The program has been compiled by using the alfa-language—a subset of the ALGOL-60 language. (auth)

24246 HOT-COLD PLASMA INTERACTIONS IN THE EARTH'S MAGNETOSPHERE. Williams, D. J. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA)). pp 161-177 of Magnetospheres of the Earth and Jupiter. Formisano, V. (Ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

A synopsis of observations and results obtained from the Explorer 45 satellite which pertain directly to the interaction of the magnetospheric hot and cold plasma populations is presented. Explorer 45(S^3) was launched on November 15, 1971 into an elliptical orbit having an apogee of 5.24 R/sub E/, a perigee of 220 km, a period of 7.82 h and an inclination of 3.5°. An electrostatic analyzer-channeltron instrument plus three separate solid state detector systems measure proton intensities from 0.73 keV to 872 keV in 28 energy steps and electron intensities from 0.73 keV to 560 keV in 20 steps. This report considers only the proton data. (NL)

24247 CALM AND TURBULENT STATE OF THE EARTH'S MAGNETOSHEATH FROM DECEMBER 1968 THROUGH MARCH

1970. Amata, E. (European Space Research and Technology Centre, Noordwijk (Netherlands)). pp 25-38 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In the past years several authors have studied the magnetic field oscillations in the magnetosheath and developed different but basically complementary ideas about their origin. This is quite understandable if one bears in mind the most outstanding feature of the magnetosheath structure, i.e. its large variability: although at times the magnetic field undergoes rather ordered oscillations, in other occasions these are very chaotic; moreover it is by no means unusual that both "calm" and "turbulent" periods alternate many times during one magnetosheath transversal by a satellite. In this paper emphasis is put on the possible transmission and amplification of waves from interplanetary space through the bow shock (McKenzie and Westphal, 1970), checking the hypothesis, put forward, e. g. by Fairfield (1969), Barnes (1970), and Formisano et al. (1973) that upstream waves may play an important role in this process. The "turbulent" and "calm" states of the magnetosheath are dealt with and a discussion of the results is presented. (NL)

24248 ON THE EARTH'S BOW SHOCK MOTION AND SPEED. Formisano, V.; Mastrantonio, G. (Consiglio Nazionale delle Ricerche, Frascati (Italy). Lab. Plasma Spazio). pp 19-24 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The Earth's bow shock has often been shown to have rather high speed (50-150 km s^{-1}) on the basis of different methods of investigation. Voelk and Auer (1973) have recently considered the interaction of Tangential Discontinuities (TD) and Alfven waves with the bow shock in order to explain the shock motion and speed. The conclusion of these authors was that Alfven waves can cause very slow shock motions (up to 10 km s^{-1}) while a TD hitting the bow shock can generate much higher speeds if the density ratio across the TD is high enough. It is the intention, here, to verify experimentally with the HEOS-1 plasma data the importance of TD for the bow shock motion and speed. (NL)

24249 MOTIONS OF THE EARTH'S BOW SHOCK. Auer, R. D. (Max-Planck-Institut fuer Physik und Astrophysik, Garching; Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). pp 11-17 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Many aspects of the interaction of the solar wind with the geomagnetic field can be successfully treated by macroscopic fluid equations. This fact can be attributed to the organizing influence of the frozen in magnetic field. The details of the turbulent dissipation processes in the collisionfree shock are, of course, only amenable to a kinetic theory. However, the gross characteristics of the bow wave (e.g. the discontinuous change of parameters across the shock) can be derived from the model equations of a two-fluid magnetized plasma. The magnetohydrodynamic description in terms of a single fluid has been applied to the impulsive nonlinear interaction of the bow shock with discontinuity surfaces in the solar wind. Attention is given to the interaction with directional discontinuities (i.e. changes in magnetic field direction only). Moreover, as long as the position and the shape of the shock are discussed in a global manner, ordinary gasdynamic theory will give sufficiently accurate results. (NL)

24250 UPSTREAM ESCAPE OF ENERGIZED SOLAR WIND PROTONS FROM THE BOW SHOCK. Greenstadt, E. W. (TRW Systems Group, Redondo Beach, Calif. (USA). Space Sciences Dept.). pp 3-10 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Recently, there have been some systematic observations of backstreaming protons at the Earth's bow shock with parallel velocity components and total energies much too high to be associated with the usual long-period upstream waves or to be produced by Sonnerup's simple reflection process (Lin et al., 1974), and these protons (30-100 keV) were attributed to some unknown acceleration mechanism in the upstream region. The observations of Lof et al. involved protons in high pitch angle, and, although their reasons for favoring an upstream acceleration were quite different, it may seem intuitive that high pitch angle particles would have difficulty escaping the shock, especially at large field-normal angles. Such an inference would superficially support the notion of energization outside the bow shock. It seems worthwhile therefore to examine the extent to which the geometry of individual particle motion alone might select among reflected particles those that can escape upstream and those that cannot. In this paper the geometry of escape is described and some simple numerical examples are worked out for a few special cases. It is found that protons with rather high energies and pitch angles can escape the shock at only marginally quasi-parallel field orientations (i.e., $\theta_{nB} \sim 50°$), even if they have quite moderate speeds parallel to B. (NL)

24251 EVIDENCE FOR MAGNETIC FIELD LINE RECONNECTION IN THE SOLAR WIND. Formisano, V. (Consiglio Nazionale delle Ricerche, Frascati (Italy), Laboratorio Plasma nello Spazio); Amata, E. (Imperial Coll. of Science and Technology, London (UK). Dept of Physics). pp 205-217 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Since the plasma conditions in space are very different from laboratory experiments and may change appreciably with time it is thought that an experimental study of the reconnection problem over a wide range of parameters may considerably improve the understanding of this important process. Data from HEOS 1 and from OGO 5 were therefore analyzed, first to find positive evidence for the reconnection process and then to perform a quantitative study of the phenomenon. In this report a few observations that provide evidence for the reconnection process in the solar wind are discussed. (NL)

24252 NEUTRAL SHEETS. Dungey, J. W. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). pp 197-204 of Magnetospheres of the Earth and Jupiter. Formisani, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

As the theory has progressed, the topic of neutral sheets has developed into an extensive subject area. This statement is not based on neutral sheets occurring frequently in nature, though they well may, but on the complexity of the neutral sheet in the geomagnetic tail, which is the best observed and towards which most theoretical work is aimed. It is found that the structure and behavior of a neutral sheet depends on the charged particle population in neighboring regions, so that other cases would require modified models. (NL)

24253 ELECTRIC FIELD EFFECTS ON THE ACCESS OF MAGNETOSHEATH PLASMA TO THE DISTANT MAGNETOTAIL. Bird, M. K. (Bonn Univ. (F. R. Germany). Inst. fuer Astrophysik und Extraterrische Forschung). pp 189-196 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

The field model used in the trajectory calculations of Bird (1974) was based on a self-consistent calculation of the tail magnetic field under very quiet conditions (Bird and Beard, 1972). Only drift and magnetization currents in the plasma sheet and on the tail boundary were considered sources of the observed magnetic field. Recent trajectory calculations by Pudovkin and Tsyganenko (1973) yielded results qualitatively similar to those of Bird (1974), but no analysis of particle access from the magnetosheath was made. Both models assumed the electric field to be zero. A more relatistic model, in view of the highly variable solar wind flux, would be to include the possibility of non-vanishing electric fields. The effects of a constant dawn-to-dusk electric field of arbitary strength on the penetration of magnetosheath protons along the down magnetotail flank is investigated in this paper. (NL)

24254 CONCEPTS OF MAGNETOSPHERIC CONVECTION. Vasyliunas, V. M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept of Physics). pp 179-188 of Magnetospheres of the Earth and Jupiter. Formisani, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Magnetospheric physics, which grew out of attempts to understand the space environment of the Earth, is becoming increasingly applicable to other systems in the Universe. Among the planets, in addition to the Earth, Jupiter, Mercury, Mars and (in a somewhat different way) Venus are now known to have magnetospheres. The magnetospheres of pulsars have been regarded as an essential part of the pulsar phenomenon. Other astrophysical systems, such as supernova remnant shells or magnetic stars and binary star systems, may be describable as magnetospheres. The major

concepts of magnetospheric physics thus need to be formulated in a general way not restricted to the geophysical context in which they may have originated. Magnetospheric convection has been one of the most important and fruitful concepts in the study of the Earth's magnetosphere. This paper describes the basic theoretical notions of convection in a manner applicable to magnetospheres generally and discusses the relative importance of convective corotational motions, with particular reference to the comparison of the Earth and Jupiter. (NL)

24255 DRIFT OF PARTICLE AND WAVE-PARTICLE INTERACTIONS. Solomon, J. (Centre National d'Etudes des Telecommunications (CNET), 92 – Issy-les-Moulineaux (France)). pp 153-159 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

To improve the comprehension of the Earth's magnetosphere it is necessary to couple the dynamic of the particles and the plasma instabilities. Here the effect on the ion-cyclotron interaction of the sudden appearance of hot protons on the nightside of the outer zone magnetosphere during substorms is studied. First, the dispersion relation of the electromagnetic ion-cyclotron waves (propagating parallel to the static magnetic field) in a finite β plasma and the respective effects of the cold and hot particle densities are considered. Second, the effects of the gradient-curvature magnetic drift on the distribution function and on the ion-cyclotron interaction are examined. Last the radial drift due to the electric field is mentioned. (NL)

24256 WAVE-PARTICLE INTERACTIONS IN THE OUTER MAGNETOSPHERE: A REVIEW. Fredricks, R. W. (TRW Systems Group, Redondo Beach, Calif. (USA)). pp 113-152 of Magnetospheres of the Earth and Jupiter. Formisani, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974). 123 refs.

The present review is restricted to only wave-particle interactions and their implication in outer magnetospheric phenomena. Thus, large bodies of low-altitude applications are not covered at all. Even within the arbitrarily chosen boundaries of the outer magnetosphere, some areas have been left out in which wave-particle interactions play crucial roles. Wave-particle interactions are important to the detailed understanding of many geophysical phenomena. Their role as currently understood in the Earth's bow shock is discussed, with the conclusion that their role in proton thermalization remains a mystery. The magnetopause region is considered and it is pointed out that practically nothing is understood there on sound theoretical grounds. The role of wave-particle interactions due to VLF and ELF electromagnetic waves and electrostatic waves present in the plasmaspheric and exo-plasmaspheric regions of the outer magnetosphere is reviewed. The state of knowledge of current-driven turbulence, and anomalous resistivity produced by it (a wave-particle interaction) in the outer magnetosphere is also reviewed. (NL)

24257 RESPONSE OF THE MAGNETOSPHERE TO THE SOLAR WIND. Russell, C. T. (California Univ., Los Angeles (USA)). pp 39-53 of Magnetospheres of the Earth and Jupiter. Formisano, V. (Ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Almost seventeen years have elapsed since the first probes were sent into the Earth's magnetosphere. Since that time the understanding of the magnetosphere has gradually evolved to the point that now a clear, although at times qualitative, understanding of the dominant physical mechanisms at work in the terrestrial magnetosphere is available. Many of these processes undoubtedly occur in the magnetosphere of Jupiter also. While their relative importance will be altered by the different scales of the parameters in the Jovian magnetosphere, the understanding of Jupiter will be hastened by the experience in studying the Earth. To set the stage for the Pioneer 10 results, the terrestrial magnetosphere, its topology, morphology dynamics and how the solar wind transfers energy to the magnetosphere is first reviewed. Attempts to predict magnetospheric response to interplanetary conditions are then reviewed and then finally the possibility of inferring interplanetary parameters from geomagnetic records is discussed. (NL)

24258 SUBSTORM EFFECTS ON THE NEUTRAL SHEET INSIDE 10 EARTH RADII. Thomas, B. T.; Hedgecock, P. C. (Imperial Coll. of Science and Technology, London (UK)). pp 55-70 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

In this paper evidence is provided that during the growth phase of a substorm or during very disturbed periods the neutral sheet may be observed as close to the Earth as approximately 7 R_E. ATS 1, in geostationary orbit at 6.6 R_E, observes more tail-like fields prior to a substorm onset but no neutral sheet observations have been reported. During the growth phase of a substorm the plasma sheet at approximately 8 R_E from the Earth has been observed to become very thin. It has been proposed that coincident with the substorm onset the plasma sheet may neck to form a localized neutral point which then propagates down the tail. This hypothesis is deduced from OGO-5 observations at 8 R_E from the Earth, just above the geomagnetic equator and the observations in this region strongly support their findings. (NL)

24259 PLASMA SHEET BOUNDARY AND K_p. Freeman, J. W. (Rice Univ., Houston, Tex. (USA). Dept. of Space Science). pp 71-75 of Magnetospheres of the Earth and Jupiter. Formisano, V. (ed.). Dordrecht, the Netherlands; Reidel Publishing Company (1975).

From symposium on the magnetospheres of the Earth and Jupiter; Frascati, Italy (28 May 1974).

Freeman and Maguire (1967) first drew attention to the intrusion of energetic plasma from the tail to the geostationary orbit during geomagnetically disturbed times. Vasyliunas (1968) reported a correlation between the inward extension of the inner boundary of the plasma sheet and the K_p index and pointed out that the plasma sheet could occasionally reach the geostationary orbit distance. More recently McIlwain (1972) using the more refined detectors aboard the ATS-5 geostationary space-craft, has emphasized the correlation between the location of the plasma sheet boundary along the ATS orbit and geomagnetic activity. Using some older but unpublished data from the Suprathermal Ion Detector aboard the ATS-1 geostationary satellite, the relation between the local time occurrence of the plasma sheet at the geostationary orbit (6.6 R_E) and K_p index is reported and then a relationship for the shift in the plasma sheet radial position is derived. (NL)

24260 APPLICATION OF MULTIVARIATE AUTOREGRESSIVE SPECTRUM ESTIMATION OF ulf WAVES. Ioannidis, G. A. (Univ. of California, Los Angeles). Radio Sci.; 10: No. 12, 1043-1054(Dec 1975).

The estimation of the power spectrum of a time series by fitting a finite autoregressive model to the data has recently found widespread application in the physical sciences. The extension of this method to the analysis of vector time series is presented here through its application to ULF waves observed in the magnetosphere by the ATS 6 synchronous satellite. Autoregressive spectral estimates of the power and cross-power spectra of these waves are computed with computer programs and are compared with the corresponding Blackman–Tukey spectral estimates. The resulting spectral density matrices are then analyzed to determine the direction of propagation and polarization of the observed waves. (auth)

24261 RELATIONSHIPS OF THE CHARACTERISTICS OF MAGNETOHYDRODYNAMIC WAVES TO PLASMA DENSITY GRADIENTS IN THE VICINITY OF THE PLASMAPAUSE. Lanzerotti, L.J.; Fukunishi, H. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Geophys. Res. 80: No. 34, 4627-4634 (1 Dec 1975).

Top side electron density data obtained during the hours of ~2100–2400 LT from the ionosphere sounder on the Isis 2 satellite are used to give indications of possible latitude gradients in the magnetospheric plasma density distributions. Studies are made of the amplitude and polarization characteristics of magnetohydrodynamic waves that occur in the frequency range of ~10–30 mHz at $L \sim 3.2$ to $L \sim 4.4$ during time intervals of Isis 2 passes. It is found that reversals in the sense of wave polarization occur in the vicinity of latitudes where L shell gradients are observed in the electron density distributions. The results of this study give strong support for the importance of magnetosphere plasma density gradients and the plasmapause in coupling ULF driving energy sources to locally resonant magnetospheric field lines. (auth)

24262 MOMENT TRANSPORT EQUATIONS FOR WAVE-PARTICLE INTERACTIONS IN THE MAGNETOSPHERE. Cornwall, J.M. (Space Physics Laboratory, Aerospace Corporation, El Segundo, California 90245). J. Geophys. Res. 80: No. 34, 4635-4642 (1 Dec 1975).

The particle transport equation which describes radial diffusion combined with quasi-linear diffusion by waves is analytically intractable and is usually dealt with by fixing a priori either the radial transport term or the wave diffusion term. For the case of electromagnetic cyclotron waves we simplify by taking moments of this equation,

thereby generating three equations for the total number density $\langle N \rangle$ of the energetic particles, their total energy $\langle NE \rangle$, and their total perpendicular energy $\langle NE_\perp \rangle$. The quasi-linear conservation equations for $\langle NE \rangle$ and $\langle NE_\perp \rangle$ allow us to estimate the total wave intensity in terms of the particle moments and their radial derivatives and thus to express wave diffusion entirely in terms of these moments. The resulting moment transport equations for the particles describe relaxation of $\langle NE \rangle$ toward a critical value $\langle NE \rangle_c$ (or equivalently a critical value β_c of the plasma β); when $\langle NE \rangle$ is less than $\langle NE \rangle_c$, there can be no finite amplitude waves. From $\langle NE \rangle_c$ we can estimate a critical flux value which is never greater than the stably trapped flux limit (STFL) of Kennel and Petschek. We show that the STFL controls the anisotropy of the energetic plasma, while $\langle NE \rangle_c$ controls the loss rate. As one expects, the effective loss rate is greater for $\langle NE \rangle$ than for $\langle N \rangle$, since particles may lose energy before they are precipitated. (auth)

24263 REQUIREMENTS ON SINGLY IONIZED LITHIUM CONCENTRATIONS FOR MAGNETOSPHERIC SEEDING EXPERIMENTS. Cuperman, S.; Gomberoff, L.; Sternlieb, A. (Department of Physics and Astronomy, Tel Aviv University, Ramat Aviv, Israel). J. Geophys. Res. 80: No. 34, 4643-4647 (1 Dec 1975).

Optimum concentrations of singly ionized Li relative to warm protons, $\eta \equiv n_{Li}/n_{p,w}$, for magnetospheric seeding experiments aimed at enhancing the electromagnetic proton cyclotron instability have been obtained analytically and numerically. This has been done by calculating the absolute maximum growth rates $\gamma_{max}{}^{abs}$ and enhancement $F \equiv \gamma_{max}{}^{abs}/\gamma_{max}(\eta=0)$ for the proton instability branch upon addition of cold lithium ions to an infinite anisotropic proton plasma. A necessary condition for enhancement is $P \equiv \beta_p A_p^2 (A_p+1) < 1$, where $\beta_p \equiv 8\pi n_p KT|_p / B_0{}^2$ and $A_p \equiv (T_\perp/T_\parallel)_p - 1$. The shape of the linearly unstable spectrum strongly depends on the parameter $[A_p/(A_p+1)]/(m_{Li}/m_p)^{-1}$. When the condition stated above is satisfied, the growth rate and the extension of the unstable spectrum in k space may increase with η. An optimum η value is found to exist. (auth)

24264 COMPLETE PLASMA DROPOUTS AT VELA SATELLITES DURING THINNING OF THE PLASMA SHEET. Lui, A.T.Y. (Department of Physics, University of Calgary, Calgary, Alberta, Canada); Hones, E.W. Jr.; Venkatesan, D.; Akasofu, S.; Bame, S.J. J. Geophys. Res. 80: No. 34, 4649-4659 (1 Dec 1975).

Five satellite years of Vela data are examined for plasma sheet thinnings. Complete proton disappearances (plasma dropouts) are the main subject here. During such times, the Vela satellite is temporarily in the high-latitude tail lobe. The distribution of such plasma dropouts within the magnetotail suggests that the semithickness of the plasma sheet near midnight seldom reaches less than 1 R_E during substorms and that the dawn and dusk portions of the plasma sheet remain thicker than the midnight portion. But it is also shown that the plasma sheet occasionally becomes very thin near the dusk magnetopause. This seems to occur when the magnetopause near the dawn and dusk meridians lies further away from the earth than is normal. Extension of the magnetopause to these greater distances does not seem to be related to magnetically quiet periods nor to the Z component of the interplanetary magnetic field (IMF). No such severe thinnings of the plasma sheet are found near the dawn magnetopause. Plasma dropouts can occur regardless of the sign of the Z component of the IMF, but their frequency of occurrence seems to be greater when the Z component is negative. The decreased frequency of occurrence with northward IMF may reflect weaker thinning of the plasma sheet at $\sim$18 R_E during the weaker substorms that occur then. Weaker thinning of the plasma sheet may also imply a greater than normal distance from the earth to the magnetic neutral line thought to form in the magnetotail at substorm onset. Three plasma dropouts which occurred in the midnight sector at unusually large distances from the estimated position of the neutral sheet were observed during geomagnetic storms. It is likely that the midnight sector of the plasma sheet can become very thick ($\sim$18 R_E) at certain times during the main phase of storms. Detailed measurements in the plasma sheet were obtained near the beginning of a geomagnetic storm whose sc triggered a substorm. A compression of the plasma sheet at $X_{SM} \simeq -15$ R_E occurred about 10 min after the sc onset at the earth and about 5 min after the start of plasma sheet thinning associated with the sc-related substorm. If compression-thinning of the plasma sheet initiated this substorm, the triggering action must have occurred earthward of $X_{SM} \simeq -15$ R_E. (auth)

24265 MAGNETIC MERGING IN A COLLISIONLESS PLASMA. Hill, T.W. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 80: No. 34, 4689-4699 (1 Dec 1975).

This paper examines the problem of magnetic merging in a fully collisionless plasma, i.e., a plasma of noninteracting charged particles, explicitly avoiding the fluid (MHD) approximation. The Alfvén self-consistency criterion that relates the plasma density to the electric and magnetic fields is shown to be equivalent, when suitably generalized, to the stress-balance requirement discussed by Rich, Vasyliunas, and Wolf. From this criterion the self-consistent electric field and the magnetic merging speed are obtained as functions of the magnetic field configuration and of the incident plasma parameters. The merging speed obtained for equal antiparallel fields is within a factor of 2 of the result of fluid theory if the incident plasma pressure is initially isotropic. The merging speed is respectively reduced or enhanced when the incident parallel plasma pressure $P_\parallel$ is greater than or less than the incident transverse pressure $P_\perp$. When $P_\parallel - P_\perp = B^2/\mu_0$ (the marginal fire hose stability condition), merging ceases. For the more general field configuration wherein the opposing magnetic fields B_1 and B_2 have arbitrary magnitudes and directions the merging electric field is shown to have a maximum value when the fields are antiparallel and to decrease monotonically to zero as the angular separation of the fields decreases to arccos (B_1/B_2). The expected merging electric field at the day side magnetopause as a function of the strength and direction of the interplanetary magnetic field is presented in a form that can be compared directly with observations. Although a detailed comparison is not feasible, the general results of the analysis are compatible with available observations in the magnetosphere and solar wind. (auth)

24266 WHISTLER OBSERVATIONS DURING A MAGNETOSPHERIC SUDDEN IMPULSE. Park, C.G. (Radioscience Laboratory, Stanford University, Stanford, California 94305). J. Geophys. Res. 80: No. 34, 4738-4740 (1 Dec 1975).

Whistlers recorded at Siple, Antarctica (76°S, 84°W), show sudden changes in nose frequency (f_n) in response to a magnetospheric sudden impulse (si) on June 9, 1973. These changes are partly due to changes in local magnetic field strength and partly due to the motion of the duct under the influence of induced electric field. This example is used to illustrate how ground-based VLF radio techniques can be used to monitor the dynamic response of the magnetosphere to shocks and discontinuities in the solar wind. (auth)

24267 TRANSIENT OCCURRENCE OF MAGNETIC LOOPS IN THE MAGNETOTAIL. Bowling, S.B. (Department of Space Physics and Astronomy, Rice University, Houston, Texas 77001). J. Geophys. Res. 80: No. 34, 4741-4745 (1 Dec 1975).

A detailed analysis of Explorer 34 magnetometer data indicates that during periods of enhanced geomagnetic activity ($Kp \geq 3$) localized regions of the magnetotail are disrupted by magnetic turbulence whose signature is consistent with the presence of closed looplike structures. These turbulent features, which exhibit rapid fluctuations in both the magnitude and the direction of the field, occur at irregular intervals and last no longer than a few hours. They have not been observed for $Kp < 3$ and do not appear to dominate the magnetotail field geometry even during periods of enhanced geomagnetic activity. (auth)

24268 FURTHER OBSERVATIONAL EVIDENCE REGARDING THE ORIGIN OF PLASMASPHERIC HISS. Thorne, R.M. (Department of Meteorology, University of California, Los Angeles, California 90024); Barfield, J.N. Geophys. Res. Lett. 3: No. 1, 29-32 (Jan 1976).

Explorer 45 satellite observations of medium energy electrons and ELF waves (100–1000 hz) have been analysed during a modest isolated substorm which occurred at about 0430 UT on Feb. 13, 1972. Approximately 50 minutes before the sharp rise in AE the electron flux (E$\sim$30–240 KeV) measured within the plasmapause near dusk at L=5 dropped below the normal quiet time level. Simultaneously the intensity of plasmaspheric hiss emissions fell to background levels. Following the substorm activity the electron flux recovered and plasmaspheric emissions first reappeared when the electron flux (E$>$30 KeV) attained a value comparable to the Kennel-Petschek stably trapped level required for cyclotron resonant instability. The substorm associated electron flux reduction is explained as a modification in the drift orbits of geomagnetically trapped electrons caused by the onset of a large scale convection electric field. The simultaneous wave and particle observations are consistent with electron cyclotron resonant generation for plasmaspheric hiss emissions. During this relatively quiet period the source location appears to be restricted to the outer plasmasphere ($L \gtrsim 5$). (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 23662, 23902, and 23909.

24269 (CONF-751048-5) PRELIMINARY EVALUATION OF A MODIFIED MUELLER–HORTIG GEOMETRY NEGATIVE ION SOURCE USING A NEGATIVE ION SOURCE TEST FACILITY. Alton, G. D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $3.50.

From international conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A negative sputter-type ion source of the Mueller-Hortig geometry is described which utilizes a positive surface ionization source. Among the ion beams which have been produced are: Al-0.2 mu A; AlO^--3 mu A; Au^--6 mu A; C^--25 mu A; C_2^--20 mu A; Cl^--100 mu A; Cu^--0.5 mu A; CuO^--0.8 mu A; F^--40 mu A; I^--26 mu A; O^--30 mu A; Pt^--3 mu A; S^--44 mu A; TaO_2^--2 mu A. The yields of Cl^-, F^-, O^-, and S^- produced from gaseous or high vapor pressure compounds are observed to be sensitively dependent on the metallic surface from which they are generated, indicating an intermediate surface chemical effect. While the source produces very intense beams of the halogens, sulfur, and oxygen and relatively intense beams of the metallic oxides, there appears to be a need for additional surface cesium to ensure maximum negative ion yields from many of the elemental materials. (auth)

24270 (COO-2425-3) STUDY OF ELECTRON AND UV PHOTON SURFACE INTERACTIONS. Progress Report, March 1, 1975–February 28, 1976. Lichtman, D. (Wisconsin Univ., Milwaukee (USA)). Nov 1975. Contract AT(11-1)-2425. 10p. Dep. NTIS $3.50.

A report is given of progress in investigations on electron induced desorption, the photodesorption process, and the development of a critical review on both electron and photon induced desorption, especially as they relate to the controlled thermonuclear research program. (GHT)

24271 (DESY-L-Ueb-204) INTERACTION OF A RELATIVISTIC HIGH-ENERGY PARTICLE BEAM WITH A CORRUGATED WAVEGUIDE. Gapanovich, V. G.; Lebedev, A. N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jun 1975. 12p. (In German). INIS.

3 figs.; 1 tab.; 7 refs. Translated from Zh. Tekh. Fiz. (1975). v 45(4) p. 844-851. Available from ZAED.

The propagation of an intense particle beam in an infinitely periodic corrugated waveguide is investigated theoretically. The longitudinal instabilities of a continuous beam are treated in linear approximation as well as the non-linear state. The results are compared with a discrete beam model for a practical example. (DE)

24272 (LA-6019) NEGATIVE ION BEAM PROCESSES. Hayward, T. D.; Lawrence, G. P.; Bentley, R. F.; Malanify, J. J.; Jackson, J. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 31p. Dep. NTIS $5.00.

Los Alamos Scientific Laboratory fiscal year 1975 work on production of intense, very bright, negative hydrogen (H^-), ion beams and conversion of a high-energy (a few hundred MeV) negative beam into a neutral beam are described. The ion source work has used a cesium charge exchange source that has produced H^- ion beams greater than or equal to 10 mA (about a factor of 10 greater than those available 1 yr ago) with a brightness of 1.4×10^9 A/m^2-rad^2 (about 18 times brighter than before). The high-energy, neutral beam production investigations have included measurements of the 800-MeV H^--stripping cross section in hydrogen gas (sigma/sub -10/, tentatively 4×10^{-19} cm^2), 3- to 6-MeV H^--stripping cross sections in a hydrogen plasma (sigma/sub -10/, tentatively 2 to 4×10^{-16} cm^2), and the small-angle scattering that results from stripping an 800-MeV H^- ion beam to a neutral (H^0) beam in hydrogen gas. These last measurements were interrupted by the Los Alamos Meson Physics Facility shutdown in December 1974, but should be completed early in fiscal year 1976 when the accelerator resumes operation. Small-angle scattering calculations have included hydrogen gas-stripping, plasma-stripping, and photodetachment. Calculations indicate that the root mean square angular spread of a 390-MeV negative triton (T^-) beam stripped in a plasma stripper may be as low as 0.7 mu rad. (auth)

24273 MULTIPHONON ATOMIC SCATTERING BY SOLID SURFACES. Lagos, M.; Birstein, L. (Comision Chilena de Energia Nuclear, Santiago). Surf. Sci.; 52: No. 2, 391-400(Oct 1975).

A multiphonon solution for the problem of atom-surface scattering at thermal energies is proposed. The scattering equations are solved using the assumption of low inelastic scattering intensities, and the theoretical formalism is basically an improvement of a previous work on one-phonon scattering. Present results reduce to the one-phonon expression of the previous work when the appropriate limit is taken. (NL)

24274 INTERPRETATION OF RAINBOW SCATTERING IN GAS ATOM/SURFACE COLLISIONS. Jewsbury, P. (Leicester Univ. (UK)). Surf. Sci.; 52: No. 2, 325-329(Oct 1975).

A model is proposed to explain the scattering of thermal energy atoms from surfaces. The model allows the behavior of the scattering trajectories to be assessed. It is shown that when a collimated beam of Neon atoms is scattered from the LiF(100) surface, the peaks observed in the inplane distribution of scattered atoms versus angle of reflection arise from trajectories with one and two repulsive collisions with the same surface atom. (NL)

24275 MASS SPECTROMETRIC STUDY OF THE BINARY APPROXIMATION IN SCATTERING OF LOW ENERGY IONS FROM SOLID SURFACES. Tongson, L. L.; Cooper, C. B. (Delaware Univ., Newark (USA). Dept. of Physics). Surf. Sci.; 52: No. 2, 263-269(Oct 1975).

The validity of the binary collision approximation (in a "single scattering" event) when low energy inert gas ions are scattered from the surface of a copper target was investigated. He and Ne ions of energies 20–1000 eV were incident on the surface of a polycrystalline target at 45°; ions scattered at 90° with respect to the incident beam direction were analyzed using a magnetic sector mass spectrometer. The scattered ions were identified and their energies measured. The binary collision approximation was found to be valid for primary ion energies as low as 40 eV for the He–Cu system, and 20 eV for the Ne–Cu system. No evidence of an increased "effective mass" of the target atoms was found. (NL)

24276 CONSTRUCTION AND CALIBRATION OF A FAST SUPERCONDUCTING BOLOMETER FOR MOLECULAR BEAMS DETECTION. Gallinaro, G.; Varone, R. (Genoa Univ. (Italy). Istituto di Scienze Fisiche). pp (no.A-4) 4 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

A tin bolometer evaporated on an anodized aluminum block is described. The noise equivalent power of the bolometer is of 10^{-13} watt $Hz^{-\frac{1}{2}}$ and the time constant is 3μ sec. The bolometer is a suitable fast molecular beam detector. (FR)

24277 PRODUCTION OF INTERMEDIATE ENERGY BEAMS BY HIGH SPEED ROTORS. Nutt, C. W.; Bale, T. J.; Cosgrove, P.; Kirby, M. J. pp (no.A-6) 12 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975)

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

A rotor apparatus intended for the study of gas/surface interaction processes is presently nearing completion. The carbon fiber rotors under consideration are constructed with shapes derived from long thin cylindrical rods oriented with the longest axis in a horizontal plane, and spun in a horizontal plane about an axis which is perpendicular to the long axis and passes through the mid-point of the cylinder. The beam formation processes are discussed and rotor diagrams presented. Performance of these types of high speed rotors shows them to have a very important future as sources of intermediate energy molecular beams. (FR)

24278 U. H. F. DISCHARGE AS ATOMIC HYDROGEN SOURCE FOR MASER. Gheorghiu, O.; Gheorghe, V.; Giurgiu, L.; Mandache, C. (Institutul de Fizica Atomica, Bucharest (Romania)). pp (no.A-5) 13 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The hydrogen atomic beam for a maser was realized with a

U.H.F. discharge produced between the plates of the capacitor of a capacitively loaded coaxial cavity at 400 MHz. The degree of dissociation of hydrogen molecules in the discharge and the atomic flux through the collimator of the source were estimated. (FR)

24279 A SUPERSONIC MOLECULAR JET GENERATOR OPERATING AS MONOCHROMATOR IN THE 10^{-2} TO 40 eV RANGE. Campargue, R.; Lebehot, A.; Lemonnier, J. C.; Marette, D.; Pebay, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Chimie-Physique). pp (no.A-7) 15 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975). (In French)

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The main characteristics of a supersonic molecular beam source, operating in relatively high pressure environments (P_1 approximately 10^{-1} torr), are described. It is shown that a meaningful skimming is possible within a zone of silence of the free jet, unaffected by the background gas and located just upstream of the Mach disk, a carefully optimized skimmer design is used. This original conception allows one to obtain very high values of P_0, D, i.e. stagnation pressure x nozzle diameter, able to produce very high terminal Mach numbers (>200). Effectively, good performance is achieved: intensities from 10^{20} to 10^{21} mol. ster. s^{-1}, energies from 10^{-2} to about 40 eV with extremely narrow spreads (S speed ratio approximately 200). In addition, the results are in agreement with theoretical predictions and even with the recent quantum theory by Miller, Toennies and Winkelmann. (FR)

24280 TWIN MODULATED SUPERSONIC BEAMS APPARATUS APPLIED TO INTERACTION WITH A SURFACE CHEMICALLY ANALYSED BY S.S.I.M.S. Cavallini, M.; Nencini, G. (Snamprogetti S.p.A., Rome (Italy)). pp (no.B-4) 10 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The interaction of supersonic water saturated argon beam, with a polycrystalline silver surface was investigated by secondary ion mass spectrometry and molecular beam relaxation spectrometry. The dependence of secondary ion peak intensities of $Ag^+n(H_2O)$, $H_3O^+m(H_2O)$, $OH^-m(H_2O)$ where n = 0.....6, m = 0...4 upon surface temperature is examined in the range 80 deg K-400 deg K. Such measurements have been complemented by modulated molecular beam technique and thermal programmed desorption in order to get an evaluation of the coverage and an estimate of the kinetic interaction parameters. (FR)

24281 STUDY OF THE BACKSCATTERING OF A (He-Ne-A) RARE GAS JET ON A COPPER MONOCRYSTAL SURFACE. Lapujoulade, J.; Lejay, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Atomique). pp (no.B-1) 12 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975). (In French)

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The angular scattering and speed distribution on the (100) surface of a copper single crystal was measured for a (He-Ne-A) beam. Particular attention was paid to the cleanliness of the surface. The dependence of the scattering upon the surface temperature azimuth was especially studied. The hypothesis of tangential velocity conservation is discussed. (FR)

24282 SCATTERING OF AN ARGON BEAM BY A LIQUID GLYCERINE SURFACE. Sinha, M. P.; Fenn, J. B. (Yale Univ., New Haven, Conn. (USA)). pp (no.B-6) 9 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Molecular beams of argon from a nozzle source were scattered from a continuously renewed surface of liquid glycerine at room temperature. Angles of incidence were 30, 50 and 60 degrees relative to the surface normal. When the source gas was pure argon the incident translational energy was 0.06 eV per mole and the reflected flux showed a cosine distribution corresponding to diffuse scattering. When the source gas was 10% argon in 90% helium the incident argon energy was 0.36 eV and the reflected flux showed a substantial peak near the specular angle. With source gas of 5% argon in 95% helium the incident argon energy was 0.44 eV and the reflected flux showed a substantial peak at an angle somewhat greater than the specular anglen. (FR)

24283 USE OF MOLECULAR BEAMS FOR THE ANALYSIS OF LIQUID AND SOLID ORGANIC COMPOUNDS. Devienne, F. M.; Giroud, J. pp (no.B-7) 10 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975). (In French)

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The chemical composition of every solid can be determined by the M.B.S.A. method (Molecular Beam Surface Analysis). The method was used to analyze deposits on a filter paper, obtained by evaporation of a liquid solution, as well as liquid films with very low evaporation rate (dioctyl-azelate for instance). The S.C.I.C. method (Separation of Ions by Collision) was used to know exactly the composition of ions of fixed mass, separated by an electromagnet. The separated ions collide a target gas (helium or argon); a part of them are dissociated and the composition and structure of the primary ions can be deduced from the kinetic energy of the dissociated ions. Results obtained from such analysis of a thin film of baryum acetate on a platinum substrate are given. (FR)

24284 A NEW THEORY OF LARGE ANGLE ELASTIC SCATTERING IN CHEMICALLY REACTIVE SYSTEMS. Connor, J. N. L. (Manchester Univ. (UK)). pp (no.C-6) 13 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Complex angular momentum techniques were used to predict the possibility of oscillations and a backward glory in the elastic angular distribution of chemically reactive systems. The oscillations have a physical interpretation in terms of interference between orbiting or surface waves that propagate around the region of chemical reaction. (FR)

24285 INTERACTION OF A FREE MOLECULE STREAM WITH LIQUID SURFACES: ANALYSIS OF THE EVOLUTION OF A SYSTEM OF MANY DROPLETS IN A FREE MOLECULE STREAM. Bellomo, N.; Larosa, S. (Politecnico di Torino (Italy)). pp (no.G-1) 7 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The time dependent evolution of the distribution of diameters, velocities and temperatures of a cloud of droplets, with given initial velocity, temperature, and distribution of sizes, shot into a gas volume at fixed thermodynamical conditions is studied. A phase-change physical model is used which takes into account the kinetic theory of liquids and gases and the physics of gas-surface interaction. (FR)

24286 ON THE SEPARATION IN SKIMMED MOLECULAR BEAMS FROM FREE JET EXPANSIONS OF BINARY GAS MIXTURES. Raghuraman, P. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen (F. R. Germany)). pp (no.G-3) 10 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

An attempt was made to study the role played by the skimmer geometry on the degree of separation attained in binary jets. A spherically symmetric flow proceeding from a virtual source is considered as representing the free jets of a binary mixture expanding into a space occupied by an infinite wall at a certain distance from the source center. The problem posed is to determine the number density of each component of the binary gas mixture at a detector located at a given distance from the skimmer cone entrance. Numerical calculations were done on an IBM 370 computer for a free jet of an argon-helium mixture. (FR)

24287 SOME OBSERVATIONS ON CONDENSATION IN FREE JETS. Gallagher, R. J.; Kung, R. T. V.; Fenn, J. B. (Yale Univ., New Haven, Conn. (USA). Dept. of Engineering and Applied Science). pp (no.G-6) 7 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Incidental to a study of internal energy relaxation during free jet expansion of polyatomic gases, several phenomena associated with the onset of condensation were noted. Observations reported are related to the properties of molecular beams extracted through a skimmer from small supersonic free jets. In some experiments the effect of condensation on the total beam intensity was measured. In others the velocity distribution of beam particles was measured by a TOF (Time-of-Flight) technique. In one case a quadrupole mass filter was used to determine the individual velocity distributions of several polymeric species in a carbon dioxide beam. (FR)

24288 LEED (LOW ENERGY ELECTRON DIFFRACTION). Aberdam, M. (Grenoble-1 Univ., 38 (France)). pp 387-418 of Current Methods for Studying Gas-Surface Interactions. Meeting Organised by the Centre d'Actualisation Scientifique et Technique, Lyon, 6-7 February 1973. Lyon, France; Institut National des Sciences Appliquees (1973). (In French)

From meeting on current methods for studying gas-surface interactions; Lyon, France (6 Feb 1973). (Institut National des Sciences Appliquees (INSA), 69–Villeurbanne (France)).

The various types of systems studied by LEED, and for which the geometry of diffraction patterns is exploited, are reviewed, intensity profiles being another source of information. Two representative approaches of the scattering phenomenon are examined; the band structure theory and the T matrix approach. (FR)

24289 PENETRATION OF D^+ IONS IN NIOBIUM, AND DEUTERIUM GAS RE-EMISSION. Pisarev, A. A.; Tel'kovskii, V. G. At. Energ. (USSR); 39: No. 3, 195-198(Sep 1975). (In Russian)

The penetration of D^+ ions in niobium, and deuterium gas re-emission have been investigated. It has been shown that capture characteristics of atomic and molecular ions do not differ if the energies per deuteron and number of bombarding deuterons are equal. It has been found that deuterium capture and gas evolution are determined by several processes. The possibility is suggested that under conditions of ion bombardment there exist interstitial and substitutional deuterium solutions in niobium and hydride-like Nb_xD_y compounds. The portion of particles captured in metal by one means or another depends on the ion energy. The dependence of the coefficient of capture of D^+ ions on target temperature in the range 290–1500° K has been measured. A decrease in η begins at 340–380° K. The value $\eta = 0$ occurs at temperatures above 550–680° K. An increase in the coefficient of capture of ions has been observed at high temperatures as the ion energy increases. At room temperature this dependence does not exist. (4 figures, 18 references) (auth)

24290 DETERMINATION OF ELECTRON ENERGY DISTRIBUTION IN ION SOURCE AND GAS DISCHARGE PLASMAS BY AN ANALOGUE COMPUTER. Sen Gupta, S. N.; Chakravarti, P. K. (Saha Inst. of Nuclear Physics, Calcutta). pp 282-284 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

The information on the electron energy distribution is very vital for ascertaining the state of plasma in ion sources and other electrical discharges. The distribution function f(V) is proportional to d^2i/dV^2, the second derivative of the electron current recorded by an electrical probe in the plasma when biased by a variable voltage V, and it can be determined by the graphical double differentiation of the probe current–voltage characteristic curve. Since this graphical method is inaccurate, an analog computer on-line with an electrical probe operated by a saw-tooth voltage can be used for the determination of the second derivative of the probe current. The probe, immersed in the plasma and fed by the saw-tooth voltage, was used to send current signals to the analog-computer, which then carried out two successive differentiations of the signals. The computer output d^2i/dV^2 was then displayed on the screen of an oscilloscope. In view of the success attained with this method, applications in different plasma situations are being attempted. The method and the results so far found are discussed. 2 figures. (auth)

24291 ION BEAM APPARATUS WITH SEPARATELY REPLACEABLE ELEMENTS. Gerlach, R. L.; Rossini, G. (to Varian Associates). US Patent 3,930,163. 30 Dec 1975. Filed date 22 Mar 1974. 10p.

In an ion beam apparatus wherein ions are generated by the collision of electrons from a filamentary emitter with gas atoms in the vicinity of an electron-attracting grid structure, with subsequent extraction of the ions so generated from the vicinity of the grid structure and the focusing of these ions into a beam by an electrostatic lens system, a new way of mounting the ion extractor and the electrostatic lens system is disclosed which facilitates the removal and replacement of the filament and the grid structure. A configuration of the grid structure is also disclosed which optimizes the profile and the current density of the ion beam. (auth)

24292 ON THE THEORY OF DIFFRACTION OF MAXWELLIAN ATOMIC BEAMS BY SOLID SURFACES. Goodman, F.O. (Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1). J. Chem. Phys. 64: No. 3, 1051-1057 (1 Feb 1976).

In the context of diffraction of Maxwellian (thermal) atomic beams by solid surfaces, the usual assumption that the angular position of the maximum in a diffracted beam corresponds to the diffraction angle of atoms with the most probable de Broglie wavelength is examined, and compared with other possible criteria and with the correct result. It is concluded that, although this criterion may be the best simple one available, it is certainly bad in some situations; the reasons why, and the conditions under which, it is expected to be good are discussed. Also, it is shown that considerable care must be taken when shapes of diffracted beams and when angular positions of their maxima are calculated, because certain physical effects (which are always present) may change these shapes and positions in unexpected ways. The theory is compared with two sets of relatively modern experimental data, one set for which the fit is good, and another set for which a fit is impossible. (auth)

24293 OBSERVATION OF ANODE IONS ASSOCIATED WITH PINCHING IN A RELATIVISTIC ELECTRON BEAM DIODE. Swain, D. W.; Goldstein, S. A.; Kelly, J. G.; Hadley, G. R. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 10, 4604-4605(Oct 1975).

Ions originating at the anode of a relativistic electron beam (REB) accelerator are observed at the cathode by a means of a Faraday cup. The dominant species is H^+, probably from adsorbed impurities. These ions, having energies equal to the diode voltage, are not observed until 20 to 40 J/cm^2 are deposited by the beam on the anode surface, and are closely associated with the formation of a pinch at the anode. (auth)

24294 SECONDARY ELECTRON EMISSION INDUCED BY 5-30-keV MONATOMIC IONS STRIKING THIN OXIDE FILMS. Dietz, L. A.; Sheffield, J. C. (General Electric Co., Schenectady, NY). J. Appl. Phys.; 46: No. 10, 4361-4370(Oct 1975).

An experimental investigation was made of how ion velocity and angle of incidence affect the magnitude and uniformity of secondary electron yield from thin amorphous oxide films. Flat target surfaces of Al_2O_3 and BeO in a high vacuum of 10^{-8} to 10^{-9} torr were bombarded with singly-charged positive ions of Li, Na, K, Rb, Cs, and Ni isotopes. Each of these elements has a different yield versus velocity response. The data are consistent with Parilis and Kishinevskii's prediction of a common velocity threshold. The estimate of the threshold velocity is 5.3×10^6 cm/sec. For a given element within experimental error, isotopes of different masses but with the same impact velocity produce identical average secondary electron yields. Furthermore, the statistical variances of their secondary electron frequency distributions also are identical. These results demonstrate the absence of an isotope effect on secondary electron emission. In general, secondary electron yield is not linear with ion velocity. Additional results were obtained for MgO and Ta_2O_5 surfaces. It was found that secondary electron yield depends strongly on the electronic shell structure of a projectile ion, that is, on its atomic number Z. The data can be interpreted qualitatively using the Fano–Lichten–Barat electron promotion model for ion-atom collisions when the Z's are unequal. A statistical model of secondary electron emission is described in which each ion-atom collision below a surface may result in the release of one or more electrons. In this model the random sequence or order in which target atoms are struck, the unequal amount of electronic excitation generated during collisions of a projectile ion with different kinds of target atoms, and the electronic properties of an oxide surface are all factors which shape the frequency distribution of observed secondary electrons. Each ion impact produces a pulse of secondary electrons. The statistics of ion-induced secondary electron emission are described remarkably well by the Polya (negative binomial) distribution. (auth)

Atomic and Molecular Properties

Refer also to abstracts 24351, 24360, 24596, and 24742.

24295 (DESY-L-Ueb-202) INVESTIGATION OF THE EFFECTIVE POTENTIAL BARRIER IN THE CASE OF RARE EARTH ATOMS. Kiselev, A. A.; Karosene, A. V.; Karaziya, R. I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). 1975. 10p. (In German). INIS.

2 figs.; 5 tabs.; 8 refs. Translated from the Russian journal Liet. Fiz. Rinkinys, v 13(3), 1973, p 375-385.

Based on the present tables on the Herman-Skilman potential, the potential barriers were determined for many neutral atoms and a few mathematical interrelationships in its change in the periodic system of elements are given. An analysis of the single parts in the exact effective Hartree-Fock potential was made and the change of the potential barrier in the isoelectronic series was investigated. By analyzing the behavior of the single members in the effective potential, the change of the potential barrier when filling the $4f^N$ shell in a series of neutral rare earth atoms is dealt with in this work and the special features of the "collapse" of the shell containing a few electrons, as well as the dependence of the effective barrier on the atomic excitation and on the state of the configuration concerned, are also dealt with. The theoretical considerations are anticipated through the calculated results for potential barriers in rare earth atoms. (DE)

24296 (IKF-30) PHONON DISPERSION IN CsBr. Daubert, J. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). 1973. 60p. (In German). INIS.

19 figs.; 5 tabs.; 33 refs. Available from ZAED.

The phonon dispersion in CsBr was determined at room temperature by inelastic neutron scattering. A time-of-flight apparatus was used with a pseudostatic chopper. In a large number of experiments, over 800 phonons could be measured in the planes (100) and (110). The results are in very good agreement with comparable data from other investigations. The results were compared with various model calculations. It was thus clear that by considering the polarizability, it is possible to make considerably better predictions on the course of dispersion than can be made with simpler models. By adapting the breathing shell model, in which even photons outside the main symmetry directions were considered, a parametric law could be found enabling the model calculation to well describe the data. The adapted breathing shell model was used to calculate the state density of the phonons. (DE)

24297 (TID-26944) SATELLITE STRUCTURE IN THE PHOTOELECTRON SPECTRA OF RARE GASES, SOME SIMPLE GASEOUS MOLECULES, AND ALKALI METAL HALIDES. Spears, D. P. (Oak Ridge National Lab., Tenn. (USA)). 1973. 103p. Dep. NTIS $5.50.

Thesis.

The rare gases Ar, Kr, and Xe, the alkali metal ions, and several simple molecules were studied to get insight into the excitation mechanism involved in the transitions to excited states. The satellite lines in the photoelectron spectra of both the inner and outer shells were studied. The satellite lines in the photoelectron spectra of the outer shells of the rare gases are compared with optical data. In the case of Ar and Kr, configuration interaction was found to be more important than electron shakeup. The photoelectron spectra of the valence shells of the alkali halides NaCl, KCl, KBr, RbCl and CsCl were run and the satellite structures compared with those of the rare gases. The satellite lines in the spectra of NO, N_2O, H_2O and N_2 are discussed. 9 tables, 24 figures, 66 references. (GHT)

24298 UNIMOLECULAR DISSOCIATION OF SOME SIMPLE MOLECULAR IONS. van Asselt, N. P. F. B.; Maas, J. G.; Los, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). pp (no.E-1) 3 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Spontaneous dissociation phenomena were observed for some diatomic molecular ions: H_2^+ and D_2^+, $^4He^+$ and $^3He^+$, $^{20}NeH^+$ and $^{20}NeD^+$. The experiments were performed in a mass spectrometer. Molecular ions are formed in high rotational states of the electronic ground states in the monoplasma ion source. Measured momentum distributions are presented. (FR)

24299 EXPERIMENTAL ARRANGEMENT FOR ACCURATE MEASUREMENT OF THE FREQUENCY OF A 1S–2S TRANSITION. Baklanov, E. V.; Chebotaev, V. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 38: No. 2, 215-216(Feb 1975).

Translated from Opt. Spektrosk.; 38: No. 2, 384-386(Feb 1975).

It is proposed that the resonance of a two-photon absorption be used for measuring the frequency of the 1S–2S transition and stabilizing the emission frequency of 2430 Å. (GHT)

24300 STUDIES OF THE RED ANTI-STOKES EMISSION OF ERBIUM IONS IN THE Y_2O_2S: Er, Yb PHOSPHOR SYSTEM. Garlick, G. F. J.; Richards, C. L. (Hull Univ. (UK)). J. Lumin.; 9: No. 5, 432-439(Dec 1974).

Excitation of the anti-Stokes red emission radiation from erbium ions by 1000 nm radiation in the Y_2O_2S: Er, Yb system has been investigated using a range of samples with widely varying erbium but fixed ytterbium content. A square law intensity dependence is found favoring the models of Sommerdijk and of Hewes and Sarver. Comparison of Stokes and anti-Stokes excitations of both green and red erbium emissions then eliminates the Hewes and Sarver model. Studies using twin-beam excitation as by Kuroda et al. (1000 nm plus 1500 nm) and over a range of temperatures give evidence that the previous assumption of the non-radiative, multiphonon relaxation between the $^4I_{11/2}$ and $^4I_{13/2}$ states following the first 1000 nm excitation is not satisfactory and suggest that this transition is radiative (2500 nm radiation). (NL)

24301 MULTIPHOTON EXCITATION OF VISIBLE EMISSION IN Y_2O_2S: Er, Yb PHOSPHORS BY 810 nm EXCITATION. Garlick, G. F. J.; Richards, C. L. (Hull Univ. (UK)). J. Lumin.; 9: No. 5, 424-431(Dec 1974).

During investigations of anti-Stokes effects in erbium-ytterbium doped yttrium oxysulphide phosphors an excitation of the erbium green emission due to 810 nm radiation ($^4I_{13/2} \rightarrow {}^4I_{15/2}$ transition) has been found, the effect being of a two-photon type. There is also a two-photon excited blue emission ($^2H_{9/2} \rightarrow {}^4I_{13/2}$ transition) due to the same radiation. Introduction of ytterbium impurity has a deleterious effect on the above 810 nm excitation, in contrast to its sensitization of the 1000 nm anti-Stokes excitation. To distinguish between various excitation schemes a two-beam excitation technique has been used. Results show that ytterbium inclusions lead to loss of energy from the 810 nm excitation by increasing the probability of downward transitions from the $^4F_{9/2}$ level to $^4I_{11/2}$ and $^4I_{13/2}$ states, reached after one-photon absorption. This effect is indicated by an increase in 1500 nm emission ($^4I_{13/2} \rightarrow {}^4I_{15/2}$ with ytterbium concentration. (NL)

24302 EXPERIMENTAL INVESTIGATION OF THE H^- SHAPE RESONANCE. Behringer, K.; Thoma, P. (Technische Univ. Muenchen (F. R. Germany). Elektrophysikalisches Inst.). pp 19 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Calculating scattering cross sections for the system electron-hydrogen atom Macek and Burke find an unusually narrow shape resonance at 10.222 eV, just above the n = 2 state of hydrogen. An experimental confirmation of this resonance is very desirable, but it seems to be difficult to observe it in scattering experiments. However, the electronic transition of this 1s2p state into the $(1s)^2$ ground state of the H^- ion should result in a spectral line at 1129.5 A with a width of 1.5 A, and according to oscillator strength calculations by Macek this line should be observable in a thermal hydrogen plasma. The present paper reports on the experimental investigation of a hydrogen arc plasma in the pertinent spectral range. (NL)

24303 SELECTIVE EXCITATION SPECTROSCOPY IN HELIUM AFTERGLOW PLASMAS. Moy, J. P.; Gauthier, J. C.; Geindre, J. P. (Paris-11 Univ., 91 – Orsay (France). Inst. d'Electronique Fondamentale). pp 16 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Preliminary experimental results are presented of the selective excitation by a pulsed dye laser of the triplet n = 3 states of helium in afterglow plasmas. The transient fluorescent light is observed at 90° of the laser light axis on a nanosecond time scale. Decay times are found in reasonable agreement with known radiative transition probabilities and with previously measured collisional rate coefficients. (NL)

24304 ELEMENTARY PROCESSES IN A HIGH PRESSURE HELIUM AFTERGLOW. Deloche, R.; Monchicourt, P.; Cheret, M.; Lambert, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Atomique). pp 15 of Phenomena in Ionized Gases. Vol. I. Hoelscher,

J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

A system of five differential, partial derivative, coupled equations that include all the known processes occurring in a helium afterglow has been developed to reproduce with the same set of rate coefficients experimental data obtained at room temperature and seven pressures from 5 to 100 Torr, with five different diagnostics. A complete solution of the helium afterglow is given. The electron-ion recombination mechanisms of He_2^+ are determined along with the rate coefficient of all the important elementary processes that take place. (NL)

24305 MASS-SPECTROMETRIC INVESTIGATION OF THE PLASMA ION COMPOSITION IN HELIUM PULSE DISCHARGE. Borisov, V. B.; Grigorian, G. M.; Egorov, V. S.; Zatserkovnjuk, N. M.; Pastor, A. A. (Leningradskij Gosudarstvennyj Univ. (USSR)). pp 12 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The results of mass-spectrometric investigation of the plasma in the helium D. C. and M. W. pulse discharges are reported. The plasma ion composition and the time dependence of the He_2^+ ion current have been measured under the pressure I — 10 Torr. The possible mechanism of He_2^+ production in the afterglow is discussed. (NL)

24306 MULTIPHOTON IONIZATION OF ATOMIC HYDROGEN, ABSORBING SOME EXTRA PHOTONS. Karule, E. (AN Latvijskoj SSR, Riga. Inst. Fiziki). pp 24 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

At the fixed laser radiation frequency ω the most possible photoionization process is $[V/h + 1]$ photon ionization where V is the ionization potential. Simultaneously there is the possibility of multiphoton ionization, absorbing one or more extra photons. Such processes are considered for atomic hydrogen in the ground state, generalizing to this case methods developed and used by the author earlier for multiphoton ionization of atomic hydrogen by the minimal number of photons. The interaction of the atom with a radiation field is considered in the nonrelativistic dipole approximation. (NL)

24307 SOFT-X-RAY AMPLIFIED SPONTANEOUS EMISSION VIA THE AUGER EFFECT. McGuire, E. J. (Sandia Labs., Albuquerque, NM). Phys. Rev. Lett.; 35: No. 13, 844-848(29 Sep 1975).

It is proposed that amplified spontaneous emission in the soft-x-ray region can be obtained using inner-shell population inversions arising from the Auger effect. For Na^+, it is shown that with present-day technology it appears possible to generate a pulse of 10^{-5} to 10^{-1} J in less than a nanosecond at 410 A. The possible effect of interatomic Auger processes in the solid is discussed but high-electron-density effects are not accounted for. (auth)

24308 NONADIABATIC CORE POLARIZATION AND PENETRATION CORRECTION IN ALKALI-LIKE ATOMS: MODEL COMPUTATIONS ON EXCITED STATES OF HELIUM. Young, R. H. (Eastman Kodak Co., Rochester, NY); Deal, W. J. Int. J. Quant. Chem.; 9: No. 5, 835-853(Sep 1975).

Correlation between the motion of a highly excited outer electron and that of the remaining ionic "core" of an atom is generally treated in an adiabatic approximation, in which it is assumed that the outer electron affects the core in the same way as a stationary point charge. An alternative approach to this correlation problem which avoids the adiabatic approximation is tested here on the 1s2p, 1s3d, and 1s4f states of helium. The results provide the first accurate test of the adiabatic approximation and of a simple correction for the nonzero velocity of the outer electron. The approach used is based on neglect, in the "correlation" part of the wave function, of the possibility that the outer electron comes closer to the nucleus than any core electron ("penetration"). A correction for this neglect is derived and tested on a version of the adiabatic approximation that likewise neglects penetration. (auth)

24309 RELATIVISTIC HYDROGEN ATOM. Ruijgrok, T. W. (Inst. of Theoretical Physics, Utrecht). Acta Phys. Pol., Ser. B7: No. 1, 43-57(Jan 1976).

A new quasipotential two-particle theory is presented for the description of the spinless relativistic hydrogen atom. Recoil effects are fully taken into account, but are shown to have no effect on the fine structure of the spectrum. For an infinitesimal value of the fine-structure constant α the theory has O(4) symmetry. Apart from the recoil effects the energy levels in this case coincide with those of the Dirac atom with maximum spin value. For a non-vanishing value of α the O(4) symmetry is broken in the same order in α in which the Lamb-shift occurs. The Klein paradox probably does not exist. (auth)

24310 ENERGY LEVELS OF THE FIRST SPECTRUM OF CURIUM, Cm I. Worden, E. F. (Lawrence Livermore Laboratory University of California, Livermore, California 94550); Conway, J.G. J. Opt. Soc. Am. 66: No. 2, 109-121 (Feb 1976).

The curium spectrum emitted by electrodeless lamps was observed from 2400 to 11 500 Å and the wavelengths of over 13 250 lines were accurately measured. Zeeman effect and spectrum-assignment plates were photographed from 2400 to 9000 Å. From data obtained on the spectrum-assignment plates, over 6800 lines were assigned to Cm I and over 4050 lines were assigned to the Cm II spectrum. The analysis of the Cm I spectrum has produced 335 odd levels and 348 even levels that combine to classify over 5025 Cm lines. Only the energy levels are presented here. The Landé g values of most levels have been obtained from the Zeeman effect data and isotope shifts were determined for many levels. These data were useful in the assignment of levels to electronic configurations of Cm I. The ground configuration of Cm I is $[Rn]5f^7\,6d\,7s^2$ and the lowest level of the $[Rn]5f^7\,7s^2$ configuration is only 1214 cm^{-1} above the ground level. (auth)

24311 RELAXATION OF THE OPTICALLY PUMPED METASTABLE 2^3S_1 STATE IN He^4. Evstaf'ev, V.V.; Zhitnikov, R.A.; Sevast'yanov, B.N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.—Tech. Phys. 20: No. 3, 416-417 (Mar 1975).

The relaxation of optically oriented helium in the 2^3S_1 state is studied by the dynamic technique. Theoretically for an arbitrary relation between the intensities of the D_0, D_1, D_2 components of the 1083 nm resonance pumping light the optical-pumping transient in helium is described by the sum of two exponentials. Experimentally, however, the process is described by a single exponential. The conditions are examined under which this occurs. (auth)

24312 ROTATIONAL MOTION UNDER PRESSURE IN THE SOLID MOLECULAR HYDROGEN ISOTOPES. England, W. (Argonne National Lab., IL); Raich, J. C.; Etters, R. D. J. Low Temp. Phys.; 22: No. 1/2, 213-222(Jan 1976).

Rotational states as functions of pressure for H_2, D_2, T_2, HD, and HT molecules are calculated in the corresponding molecular solids. Sudden transitions from spherically symmetric rotational states occur in para-H_2, para-T_2, ortho-D_2, and in HD and HT as the pressure increases. Only the predicted T_2 transition pressure of about 24 kbar lies within current experimentally accessible ranges. All other transitions occur in the region 150-300 kbar. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 24513.

24313 POSITRONIUM INTERACTIONS IN BINARY MIXTURES OF ORGANIC COMPOUNDS. Wild, R. E.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Radiochem. Radioanal. Lett.; 23: No. 4, 249-256(29 Nov 1975).

The annihilation rates of thermal o-Ps atoms in a variety of binary mixtures consisting of benzene and mono- and dihalogenated benzenes, benzylalcohols, benzylaldehyde, benzonitrile and acetophenone have been measured. The results suggest that the interactions between Ps and the molecules in these mixtures cannot satisfactorily be described by the "bubble" model. The semi-empirical correlations between surface tension and Ps annihilation rates resulting from this model as well as the additivity rule for pick-off annihilation rate in binary liquid mixtures are severely limited in their applicability to the systems studied in this investigation. A better model seems to be one which considers reversible Ps compound formation between Ps and the various types of molecules making up the mixture. (auth)

24314 EFFECT OF SOLVENTS ON THE STABILITY OF POSITRONIUM COMPLEXES IN SOLUTION. Hall, E.; Madia, W. J.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Radiochem. Radioanal. Lett.; 23: No. 4, 283-291(29 Nov 1975).

Positron lifetime measurements were carried out in a series of toluene, n-heptane and n-pentanol solutions containing substrates such as nitrobenzene or o-nitrotoluene in order to study the effects of these solvents on the stability of positronium complexes with nitrobenzene and o-nitrotoluene. The results show a distinct dependence of the stability of these Ps-complexes on the

different media. They can be attributed to changes in the entropies involved in the Ps-complex formation. (auth)

24315 POSITRON ANNIHILATION IN SINGLE CRYSTALS OF TUNGSTEN AND ALLOYS WITH RHENIUM. Dekthyar, I. Ya.; Ovsienko, D. E.; Sakharova, S. G.; Sosnina, E. I.; Fedchenko, R. G. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1616-1619(Oct 1975). (In Russian).

Angular distribution of γ-quanta is studied in single crystals of tungsten and W-Re alloys oriented in {100} and {110} planes. The difference is detected in the parameters of electron-positron annihilation as to single crystal growth axis. Crystallographic anisotropy as well as the effect produced on the parameters by addition of Re to W are found. (auth)

24316 COVALENCY EFFECTS ON MOMENTUM DISTRIBUTIONS IN COMPOUNDS: POSITRON ANNIHILATION IN Fe_3O_4. Chiba, T. (National Institute for Researches in Inorganic Materials, Kurakake, Sakura-mura, Niihari-gun, Ibaraki 300-31, Japan). J. Chem. Phys. 64: No. 3, 1182-1188 (1 Feb 1976).

A simple method based on the LCAO–MO scheme is presented for the calculation of the momentum distribution in compounds for positron annihilation or Compton scattering. The method is applied to analyze the covalency structure from the spin-density distribution in Fe_3O_4 measured by Mijnarends and Singru. The degree of covalency is found to be $f_\sigma^2=10\%$, $f_\pi^2=0.3\%$, and $f_\sigma^2=4\%$ for the antibonding orbitals of Fe^{2+} and Fe^{3+} in octahedral sites. (auth)

24317 *S*-MATRIX APPROACH TO HADRONIC ATOMS LEVEL SHIFTS. Deloff, A. (Institute for Nuclear Research, Warsaw, Poland). Phys. Rev. C 13: No. 2, 730-736 (Feb 1976).

S-matrix perturbation theory accurate to all orders in the strong interaction potential is developed. The method presented is applied to the derivation of two important relations: (a) The complex level shift in a hadronic atom is expressed in terms of the logarithmic derivative of the regular wave function at the nuclear boundary and (b) the complex level shift is related in a model independent way to the zero-energy hadron-nucleus scattering phase shift. It is shown that these two relations provide practical means for a fast and accurate evaluation of the complex level shifts and generalized scattering lengths. (auth)

Collision Phenomena

Refer also to abstracts 22886, 22914, 22915, 22926, 22939, 24272, 24292, 24646, 24660, 25001, and 25004.

24318 (BUP-79) CURRENT IDEAS ON ION-ATOM COLLISIONS. Hansteen, J. M. (Bergen Univ. (Norway). Dept. of Physics). Aug 1975. 50p. (CONF-7506108–1). Dep. NTIS (US Sales Only) $4.00.

From annual meeting of the Norwegian Physical Society; Bergen, Norway (18 Jun 1975).

A survey is given of recent developments in the understanding of ion-atom collisions, with particular emphasis on processes leading to ion-induced X-rays. The inner-shell Coulomb ionization phenomena are discussed at some length, with stress on the near-quantitative picture that appears to emerge from simple-minded models. The phenomenon of Pauli excitations and the formation of quasi-molecules leading to united atom phenomena are qualitatively reviewed together with a brief mention of target recoil effects and electron capture processes. Selected background phenomena of importance in interpreting experiments are touched upon, such as various types of bremsstrahlung production. Implications of the recently-discovered interplay between Coulomb-induced processes and united atom phenomena are especially mentioned. It is suggested that this branch of collision physics is now (1975) reaching a point where new notions and more advanced and unifying models are greatly needed. (auth)

24319 (COO-7B-15) TECHNICAL PROGRESS REPORT, OCTOBER 1, 1974–SEPTEMBER 30, 1975. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1975. Contract E(11-1)-Gen-7. 48p. Dep. NTIS $4.00.

Topics covered include: equilibrium fractions when D^+, D_2^+, or D_3^+ ions are incident on a Cs vapor target; charge exchange collisions when hydrogen and deuterium ions are incident on a Cs vapor target; charge exchange cross sections with rare gas ions incident on a Cs vapor target; the production of He^- ions in a Cs target; and direct production of polarized H^- or D^- ions. 10 figs. (GHT)

24320 (COO-3570-17) RESEARCH ON HIGH-ENERGY CHEMICAL REACTIONS. Annual Progress Report, August 1, 1974–October 31, 1975. Cross, R. J. Jr. (Yale Univ., New Haven, Conn. (USA). Dept. of Chemistry). Oct 1975. Contract E(11-1)-3570. 10p. Dep. NTIS $3.50.

Product yields for the reactions $T^* + c - C_6D_{12}$ yields $c - C_6D_{11}T$, DT have been measured using a beam of T^* formed by charge exchange in the energy range of 25 eV to 100 eV. A computer program was written to calculate the probability of collision vs. energy of a beam of T^* moderated by He gas. (auth)

24321 (IPPJ-DT-44) REPORT OF DATA COLLECTION AND ARRANGEMENT OF CROSS SECTION OF ATOMIC PROCESSES. (Nagoya Univ. (Japan)). Aug 1974. 35p. (In Japanese). Dep. NTIS (US Sales Only) $5.00.

A survey of the data concerning the cross section of atomic process was carried out. For the purpose of this survey, a questionnaire was distributed among research fellows of nuclear fusion council. The data requested in the questionnaire were those on electron impact, emission and absorption of light, collision between atoms, three body collision, width of spectral lines and others. The survey of data was made on these topics. Elastic scattering, excitation and de-excitation, ionization, recombination and electron attachment were given as the concrete contents for the electron impact. Concerning the emission and absorption of light, probability of bound-bound transition, and free-free transition was given. Elastic scattering, excitation, ionization, dissociation, ion-molecule reactions, and energy transfer were stated for heavy particle collisions. Results of the survey are also given for the three body collision and width of spectral lines. A list of the references concerning atomic processes is presented. (JA)

24322 (LBL-3529) MOLECULAR BEAM KINETICS. Behrens, R. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 299p. Dep. NTIS $9.25.

Thesis.

The design of a crossed molecular beam "supermachine" for neutral–neutral collisions is discussed. The universal electron bombardment ionizer, mass filter, and ion detection system of the detector, the supersonic nozzle sources, the differential pumping arrangement for the sources and detector, the time-of-flight detection of scattered products, and the overall configuration of the apparatus are described. The elastic scattering of two systems, $CH_4 + Ar$ and $NH_3 + Ar$, has been measured using the supermachine with two supersonic nozzle sources. The rainbow structure and the interference oscillations are seen in each system. The best fit to the data was found using a Morse–Spline–Van der Waals (MSV) potential. The three potential parameters epsilon, r/sub m/, and beta were found to be 2.20(+-0.04) x 10^{-14} ergs, 3.82(+-0.04)A, and 7.05 +- 0.20 for $CH_4 + Ar$, and 2.21(+-0.04) x 10^{-14} ergs 3.93 (+-0.05)A, and 8.45 +- 0.30 for $NH_3 + Ar$. A new phenomenon in crossed molecular beams of condensation of a molecule on a cluster to form a complex was observed. A bromine molecule condensed on clusters of chlorine (Cl_2)/sub chi/ and ammonia (NH_3)/sub chi/. The value of chi for measurements in these experiments ranges from 7 to 40 for chlorine clusters and from 10 to 70 ammonia clusters. (auth)

24323 (SAN-936X10) ENERGY DISTRIBUTIONS OF SECONDARY ELECTRONS FROM Ar, N_2, H_2O, AND H_2O WITH CLUSTERS PRESENT. Mathis, R. F.; Vroom, D. A. (IRT Corp., San Diego, Calif. (USA)). 1976. 15p. Dep. NTIS $3.50.

Crossed beam measurements have been made of the energy spectra of secondary electrons resulting from collisions of 1 keV primary electrons with N_2, Ar, H_2O, and H_2O with clusters present. Only those electrons emitted normal to the primary beams were detected. A thorough description of the apparatus is given. (auth)

24324 (TID-26983) INELASTIC MOLECULAR COLLISIONS: APPLICATION OF THEORETICAL METHODS TO PROBLEMS RELEVANT TO LASER OPERATION. Progress Report, February 1, 1975–November 1, 1975. (Wisconsin Univ., Madison, (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2555. 14p. Dep. NTIS $4.50.

Information is presented on the decomposition theory of molecular collisions for non-reactive and reactive scattering. The basic theoretical problem of calculating molecular collision phenomena is discussed. Research done in these areas from Feb. 1, 1975 to Nov. 1, 1975, is described. (GHT)

24325 TRANSFER BY ELECTRON COLLISION BETWEEN METASTABLE ($^3P_2$) AND RESONANT ($^3P_1$) STATES OF ARGON IN THE POST-DISCHARGE PHASE. Sadeghi, N. (Lab. de Spectrometrie Physique, Univ. Scientifique et Medicale de Grenoble, France). pp 17 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975). (In French)

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The effect of the electrons of an afterglow plasma on the evolution of the argon $^3P_{2,1,0}$ states populations has been analyzed. By

raising the electron temperature in the afterglow, the presence of the transitions between these levels due to collisions with electrons have been shown. A study of the decay of the $^3P_2$ and $^3P_1$ states population and of the electron density in the afterglow allowed determination of the cross section for the $^3P_2$ to $^3P_1$ transition by thermal electron (300°K) collisions. (NL)

24326 DEEXCITATION RATE CONSTANTS OF THE $^3P_{2,1,0}$ AND $^1P_1$ STATES OF ARGON BY N_2, H_2, AND CO. Le Calve, J.; Bourene, M.; Dutuit, O. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Recherche et Analyse). pp 14 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Binary (Ar/CO or H_2) or ternary (Ar/N_2/CO or H_2) gaseous mixtures were excited at pressures in the range 50–760 torr of argon and some 10^{-1} torr of additives, by a pulse of 600 keV electrons from a Febetron. Rate constants for the deexcitation of the $^3P_2$, $^3P_1$ and $^1P_1$ states of argon by CO, H_2 and N_2 were obtained by kinetic absorption or emission (of N_2) spectroscopy. (NL)

24327 PRODUCTION OF ARGON EXCIMERS. Boucique, R.; Moerman, P. (Ghent Rijksuniversiteit (Belgium). Natuurkundig Lab.). pp 13 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

In the range from 75 to 750 torr, the formation frequency of AR_2^* excimers has been found to be 18 p^2 at lower pressures and 5.3 p^2 at higher pressures. Those frequencies can be associated with the destruction frequency by 3-body collisions of the $^3P_2$ and $^3P_1$ atomic states respectively. (NL)

24328 MEASUREMENT OF THE MOMENTUM TRANSFER CROSS-SECTION OF ELECTRONS IN MOLECULAR OXYGEN. Martin, N. L. S.; von Engel, A. (Oxford Univ. (UK). Dept. of Engineering Science). pp 10 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The only data on the momentum transfer cross-section of electrons in molecular oxygen, in the energy range 0–10 eV, is that derived from transport coefficients. This paper describes a method applicable to any gas, to obtain a more direct measurement. First order diffusion theory is used to find a relationship between the gas pressure and the current arriving at a collector when electrons diffuse through a field free space. (NL)

24329 EXPERIMENTAL EVIDENCE OF ELECTRON–ATOM DIVERSE BREMSSTRAHLUNG IN ARGON. Louis-Jacquet, M.; Blanc, A. (Commissariat a l'Energie Atomique, Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). pp 27 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Electron-atom inverse bremsstrahlung is experimentally observed. A characteristic electron-cascade parameter is measured in good agreement with theoretical results. (NL)

24330 CROSS-SECTION OF ASSOCIATIVE GENERATION OF Cs_2^+ IONS FOR DIFFERENT EXCITED STATES OF ATOMS. Antonov, E. E.; Korchevoy, Yu. P.; Lukashenko, V. I.; Hilko, I. N. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrodinamiki). pp 33 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The attempt to determine the cross-section for association of two cesium atoms, either one of which or both are in excited $nP_{\frac{1}{2},\frac{3}{2}}$ or $nD_{\frac{3}{2},\frac{5}{2}}$ states has been made. (NL)

24331 MULTIPLE SCATTERING OF Ne AND Ar IONS IN THIN GASEOUS TARGETS. Efken, B.; Hahn, D.; Hilscher, D.; Wuestefeld, G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). Nucl. Instrum. Methods; 129: No. 1, 227-230(1 Nov 1975).

The small angle multiple scattering of Ne and Ar ions at 15 MeV has been measured in windowless He, N_2, SF_6, and Ar targets with target thicknesses of 0.005–20 torr. cm. At target thicknesses larger than or equal to that for reaching the equilibrium charge state distribution the results agree very well with the theory of Meyer. For very high charge states a strong charge state dependence of the angular scattering distribution is observed, characterized by a minimum at zero degree for very thin targets. (NL)

24332 INFLUENCE OF THE ATOM–ATOM COLLISIONS IN A MERCURY–ARGON DISCHARGE BALANCE. Damelincourt, J. J.; Dimitriadis, A. (Centre National de la Recherche Scientifique, 31 – Toulouse (France)); Scoarnec, L. (Compagnie des Lampes, Puteaux, France). pp 50 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Results for the balance of a mercury-argon discharge are given versus the wall temperature. The calculations were performed in two cases: (a) by disregarding the atom–atom collisions, (b) by taking the more important atom–atom collisions into account. A comparison with experimental results is made. (NL)

24333 INFLUENCE OF METASTABLE STATES ON IONIZATION PROCESSES IN N_2^+. Haydon, S. C.; Williams, O. M. (New England Univ., Armidale (Australia). Dept. of Physics). pp 43 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Combined spatial and temporal measurements of ionization growth in nitrogen have been used to separate the slow metastable particle contribution from the fast photon and positive ion effects, resulting in more reliable determination of both the primary ionization coefficients and the energy dependences of the secondary contributions over an extensive range of E/N values from 140 to 3400 Td. Inconsistencies of earlier investigations, associated with a misinterpretation of the metastable particle effect, have been resolved. (NL)

24334 ISOTOPE EXCHANGE AND VIBRATIONAL RELAXATION IN ION–MOLECULE COLLISIONS. Karachevtsev, G. V.; Tal'rose, V. L.; Vinogradov, P. S. (AN SSSR, Moscow. Inst. Khimicheskoj Fiziki). pp 44 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The processes of isotope exchange and vibrational translational relaxation in ion–molecule collisions were studied using mass-spectral technique. The efficiencies of these processes at low kinetic energies (< 0.3 eV) were estimated. Correlation diagrams and spin and orbital symmetry rules were applied to the interpretation of the results. (NL)

24335 RADIATIVE COLLISIONS OF GAS ATOMS IN THE PRESENCE OF INTENSE ELECTROMAGNETIC FIELD. Kovarsky, V. A.; Perelman, N. F.; Todirashku, S. S. (AN Moldavskoj SSR, Kishinev. Inst. Prikladnoj Fiziki). pp 25 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The peculiarities of radiative collisions in the gas consisting of two type atoms in the presence of an intense electromagnetic field are examined. The elementary process includes the collisions of the excited states. The external perturbation leads to the additional harmonics of the luminescence and opens its new channels. It is shown that Doppler form function of luminescence changes essentially in the presence of an intense external field. The mechanism under consideration may be interesting for the laser diagnostics of the slightly ionized plasma. (NL)

24336 USE OF REACTIVE MOLECULAR BEAMS FOR STUDYING OXIDATION REACTIONS OF SIMPLE GASES WITH POLYCRYSTALLINE PLATINUM. Pacia, N.; Dumesic, J.; Weber, B.; Cassuto, A.; Pentenero, A. (Centre National de la Recherche Scientifique, 54 – Villers-les-Nancy (France). Centre de Cinetique Physique et Chimique). pp (no.B-3) 10 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975). (In French)

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Reactive molecular beams are allowed to collide with a polycrystalline platinum ribbon submitted to an isotropic pressure

of another reactive gas. The method was applied to CO and H_2 oxidation, to determine reactive sticking coefficients and to isolate steps of the chemical mechanisms. (FR)

24337 NONADIABATIC AND INTERFERENCE EFFECTS IN TOTAL CROSS SECTIONS FOR INELASTIC ION-ATOM COLLISIONS. Aquilanti, V.; Casavecchia, P. (Perugia Univ. (Italy)). pp (no.C-7) 4 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The electronic excitation in collisions between alkali ions and several atoms was investigated by a crossed beam method and spectroscopic analysis of the emitted radiation. Results indicate large nonadiabatic effects, and a variety of oscillation modes in the velocity dependence of total cross sections. (FR)

24338 SYSTEMATIC TRAJECTORY STUDY ON THE REACTION K + Br_2 — KBr + Br IN THE ELECTRON VOLT ENERGY RANGE. van der Meulen, A.; de Vries, A. E. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Institut voor Atoom en Molecuulfysica). pp (no.D-2) 5 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Trajectory calculations for various potential energy surfaces in K + Br_2 reactions were extended to the electron-volt energy range. The effects studied were: recrossing of the harpoon electron, charge migration and high and low product-repulsion. In all cases the total reaction cross sections decreases and the product translation increases as a function of the collision energy of the reactants. Detailed observations are given in figures and tables. (FR)

24339 DIFFERENTIAL AND DOUBLE DIFFERENTIAL MEASUREMENTS FOR CHARGE TRANSFER COLLISIONS BETWEEN Na, K, Cs, AND I_2. Aten, J. A.; Lanting, G. E. H.; Los, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). pp (no.D-5) 3 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Charge transfer collisions between the alkali atoms Na, K, Cs and the I_2 molecule were studied in a molecular beam apparatus by means of differential and double differential (angle and alkali product ion energy) measurements. The aim of this study was two-fold. An attempt was made to obtain information about the interaction potentials and transition probabilities of the atom-molecule system in the case where the molecule can be considered to be a rigid rotator, i.e. at high collision velocities. For Na + I_2 — $Na^+ (I + I)^-$ this is the case at collision energies above 50 eV c.m. Double differential measurements at collision energies below 10 eV, on the other hand, gave us information about the energy transfer from the alkali atom to the iodine molecule for each of the collision channels. (FR)

24340 ION PAIR FORMATION IN FAST ALKALI-SF_6 COLLISIONS: ROLE OF INTERNAL ENERGY. Hubers, M. M.; Los, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). pp (no.D-5) 3 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7–11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Measurements are presented on collisional ionization of SF_6 molecules in collisions with alkali atoms, using the molecular beam method. Total cross sections for the formation of negative ions were measured at collisional energies from threshold to about 30 eV, with the SF_6 temperature as a parameter. The beam of alkali atoms (K, Na or Li) was produced by sputtering, velocity selected mechanically and crossed with an SF_6 beam. The negative ions formed were extracted in a uniform field and mass selected. The cross sections for each specific negative ion (SF_6^-, SF_5^-, F_2^- and F^-) show a different behavior with respect to relative energy and target temperature. (FR)

24341 ELECTRON TRANSFER AND REACTIVE IONIZATION IN COLLISIONS BETWEEN C AND O_2 FOR ENERGIES UP TO 15 ELECTRONVOLTS. de Vries, A. E.; Koennen, G. P.; Haring, A. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). pp (No. D-6) 3 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

Ionization processes induced in collisions between C and O_2 were studied. Carbon atoms were produced by sputtering. The total ion yields were measured as a function of the collision energy. Reactive ionization processes are dominant. (FR)

24342 SYMMETRY AND LIFETIME OF KI EXCITED IN A MOLECULAR BEAM BY 3,57 eV LIGHT. Rose, T. L.; Ormerod, R. C. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). pp (No. E-3) 9 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975).

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

The angular distribution of the potassium photofragment produced from dissociation of a KI molecular beam by 3.57 eV light was analyzed, and the asymmetry factor and lifetime derived. The asymmetry parameter indicates that at least two excited states of different symmetry are formed. The short lifetime implies that the accessible Σ^+ (or 0^+) state contributing to the parallel component dissociates immediately. (FR)

24343 DETERMINATION OF ANY GAS COMPOSITION USING HIGH ENERGY MOLECULAR BEAMS. Application to the Simultaneous Concentration Measurement of Ten Pollutants in Air. Devienne, F. M.; Laugier, L.; Roustan, J. C.; Clapier, R. pp (No. F-4) 10 p. of Proceedings of the 5th International Symposium on Molecular Beams, Nice, France, April 7-11, 1975. Peymeinade, France; Laboratoire de Physique Moleculaire des Hautes Energies (1975). (In French)

From 5th international symposium on molecular beams; Nice, France (7 Apr 1975). (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies).

A high energy argon beam collides with the gas to be analyzed in a special box. The ions formed are extracted and collide with a target gas (such as argon) filling a collision chamber, and some of them are dissociated. The number of these ions is measured by means of an electrostatic analyzer and an electron multiplier as detector. By this way, it is possible to measure the concentrations of ten or more gaseous pollutants in air in a time shorter than a minute. The method was applied to study the effluents of a jet; the concentrations in CO, NO, NO_2, CO_2 and SO_2 were measured. (FR)

24344 POPULATION TRANSFER BETWEEN 2p LEVELS OF NEON INDUCED BY NEON ATOMS IN A TWO STEP RESONANCE EXPERIMENT. Grandin, J. P.; Hennecart, D.; Husson, X.; Lecler, D.; Vienne, J. F.; Barrat-Rambosson, M. (Caen Univ., 14 (France). Lab. de Spectroscopie Atomique). J. Phys. (Paris); 36: No. 9, 787-793(Sep 1975). (In French).

One of the $2p_3$, $2p_4$, or $2p_5$ levels of neon is excited in a discharge by a tunable dye laser. The cross section for an excitation transfer from level a to level b, induced by collisions with neon atoms in their ground states, was determined by measuring the intensities of the lines emitted from this level and the neighboring ones as a function of the pressure. The values obtained are given. (FR)

24345 STUDY OF THE ROTATIONAL EXCITATION OF THE $B^2\Sigma$ STATE OF N_2^+ BY HEAVY ION IMPACT. Desesquelles, J.; Do Cao, G.; Vaissade, A. (Lyon-1 Univ., 69 – Villeurbanne (France)). J. Phys. (Paris); 36: No. 9, 795-802(Sep 1975). (In French)

A nitrogen target is ionized and excited by impact of H^+, Ne^+, Na^+ and K^+ ions in the energy range 1–120 keV. The rotational structure of N_2^+ B^2 is analyzed by photoelectric spectrometry of the $B^2\Sigma$–$X^2\Sigma$ band between 3914A and 3820A. A superposition of two Boltzmann distributions is observed, one at the laboratory temperature and the other at a higher temperature. The latter one, which can grow up to 5000 K at low energy, for alkaline ions, is due to charge exchange. Its variation with the incident beam

energy and with the energy defect of the reactions is interpreted in a classical collision model involving angular momentum transfer. (FR)

24346 EFFECT OF ORBITING RESONANCE ON THE ELASTIC DIFFERENTIAL CROSS SECTIONS. Sheen, S. H. (The Florida State Univ., Tallahassee); Skofronick, J. G.; Mueller, C. R. Int. J. Quant. Chem.; 9: No. 5, 817-824(Sep 1975).

The effects of orbiting resonances on elastic differential cross sections are investigated for the Lennard-Jones (12, 6) model potential. The elastic differential cross section consists of three terms: a resonance term, a potential scattering term and an interference term. The interference term has a significant effect only at small angles of the differential cross section. The importance of the potential scattering term depends proportionally upon the orbiting resonance energy. For the low lying orbiting resonance states, the resonance term is the dominant term, but at higher energy it appears only in the backward differential cross sections. Generally, by fitting the large angle differential cross sections, the resonance orbital angular momentum can be estimated. (auth)

24347 EVIDENCE FOR INDUCED TRANSITIONS BETWEEN MOLECULAR STATES FORMED TRANSIENTLY IN HEAVY-ION–ATOM COLLISIONS. Wolfli, W.; Stoller, C.; Bonani, G.; Suter, M.; Stockli, M. (Eidgenoessische Technische Hochschule, Zurich). Lett. Nuovo Cim.; 14: No. 16, 577-582(20 Dec 1975).

Further experimental evidence is reported that anisotropy peaks are produced by transitions between quasi-molecular states. In the study of the noncharacteristic part of the x-ray spectra produced in I–I, I–Ag, and Ag–Ag collisions several well defined peaks were found in each case. The energies of these peaks obey the well known Z^2 law, where Z is the total charge of the colliding system, and agree well with possible L and M transitions in the corresponding united system. The x-ray spectra, production cross sections, and anisotropy are shown. (JFP)

24348 TOTAL ELASTIC SCATTERING CROSS SECTIONS BY MOLECULAR BEAMS. The Interaction of Atomic and Molecular Hydrogen or Oxygen with Several Gases. Aquilanti, V.; Liuti, G.; Luzzatti, E.; Vecchio Cattivi, F.; Volpi, G. G. (Perugia Univ. (Italy)). Gazz. Chim. Ital.; 103: No. 8-9, 841-848(1973).

A molecular beam apparatus is described with particular reference to the measurement of total elastic scattering cross sections as a function of relative velocity. The results are analyzed in terms of intermolecular potentials of the Lennard-Jones type.

24349 FOCUSED INTENSE ION BEAMS USING SELF-PINCHED RELATIVISTIC ELECTRON BEAMS. Poukey, J.W.; Freeman, J.R.; Clauser, M.J.; Yonas, G. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. Lett. 35: No. 26, 1806-1808 (29 Dec 1975).

A new two-dimensional diode simulation code is used to show the possibility of using hemispherical diodes to produce converging ion beams in the 1–10-MA range. The pinched electron flow enhances ion emission, while suppressing electron emission, allowing $I_i/I_e > 1$. Such focused ion beams are of considerable interest for use in ablatively driven implosions of fusion targets. (auth)

24350 INELASTIC COLLISIONS BETWEEN AN ATOM AND A DIATOMIC MOLECULE. III. COMPARISON OF APPROXIMATION METHODS AS APPLIED TO THE $H+H_2$ ROTATIONAL EXCITATION. Choi, B.H.; Tang, K.T. (Department of Physics, Pacific Lutheran University, Tacoma, Washington 98447). J. Chem. Phys. 64: No. 3, 942-945 (1 Feb 1976).

The close coupling method is used to calculate the rotational excitation cross sections of $H+H_2$ collisions. On the potential surface suggested by Chu and Dalgarno, close coupling results are compared with results of distorted wave Born approximation and of effective close coupling approximation. On the potential surface suggested by McGuire and Krüger, close coupling results are compared with results of DWBA and of J_z-conserving coupled states approximation. The simple DWBA is generally adequate for this system, and in some cases, it is much better than other approximation methods. A third potential based on the experimental V_0 of Gegenbach, Hahn, and Toennies and the nonempirical V_2 of Norbeck, Certain, and Tang is also used. The excitation cross sections are smaller by orders-of-magnitude than the ones determined on the other two surfaces. (auth)

24351 ENERGY BANDS IN REACTIVE COLLISIONS. I. $H+H_2$ ON THE COLLINEAR SSMK SURFACE. Wright, J.S. (Department of Chemistry, Carleton University, Ottawa, Canada); Tan, K.G.; Laidler, K.J. J. Chem. Phys. 64: No. 3, 970-980 (1 Feb 1976).

The collision of $H+H_2$ on the collinear Shavitt, Stevens, Minn, and Karplus (SSMK) surface is studied for incident energies of 0–2 eV. By assuming a fixed zero-point energy for H_2, and systematically varying the incident energy of the atom and the vibrational phase angle of the molecule, the trajectories divide into a continuous series of reactive (R) and unreactive (U) bands. At the R–U boundary, trajectory times and product vibrational energies reach a maximum. From the bands, the reaction probability may be obtained with a high degree of precision. Band continuity is shown clearly by means of linear and polar plots. The reaction probabilities obtained from the band plots are discussed and compared to other quasiclassical and quantum-mechanical studies. (auth)

24352 COLLISION DYNAMICS OF THREE INTERACTING ATOMS: STRIPPING REACTIONS OF $Ar^+ + H_2$ AND OF $K+I_2$. Yuan, J.; Micha, D.A. (Quantum Theory Project, Departments of Chemistry and Physics, University of Florida, Gainesville, Florida 32611). J. Chem. Phys. 64: No. 3, 1032-1041 (1 Feb 1976).

Equations for stripping reaction cross sections, obtained from a multiple-collision expansion for triatomic systems, are applied to $Ar^+ + H_2 \rightarrow ArH^+ + H$ and its isotopic substitutions, and to $K+I_2 \rightarrow KI+I$. The equations involve the momentum distributions of reactant and product molecules, and are considered for mechanisms where stripping begins either before or after electron transfer, for both systems. Calculations of forward velocity distributions, product angular and energy distributions, isotope ratios, and total cross sections for $Ar^+ + H_2$ are in over-all agreement with experiments and indicate that stripping begins after electron transfer in these systems. Comparison with experiment of calculated product angular and energy distributions and forward velocity distributions for $K+I_2$ favors a mechanism where a vertical electron transfer occurs first, with simultaneous partial vibrational relaxation of I^-_2, followed then by stripping. Discrepancies remain however for $K+I_2$, suggesting some contribution from other mechanisms. (auth)

24353 ANALYTIC STRUCTURE OF THE EIGENVALUE PROBLEM AS USED IN SEMICLASSICAL THEORY OF ELECTRONICALLY INELASTIC COLLISIONS. Pechukas, P.; George, T.F.; Morokuma, K. (CECAM, Université de Paris XI, 91405 Orsay, France); McLafferty, F.J.; Laing, J.R. J. Chem. Phys. 64: No. 3, 1099-1105 (1 Feb 1976).

The analytic properties of eigenvalues and eigenvectors of analytic symmetric matrices of arbitrary size are discussed, with special attention given to the branch point structure at a degeneracy of two eigenvalues —that is, at a complex crossing point of two potential surfaces. The discussion is relevant to semiclassical theory of electronically inelastic collisions. (auth)

24354 DISSOCIATIVE EXCITATION OF H_2: SPECTRAL LINE SHAPES AND ELECTRON IMPACT CROSS SECTIONS OF THE BALMER LINES. Freund, R.S.; Schiavone, J.A.; Brader, D.F. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 64: No. 3, 1122-1127 (1 Feb 1976).

The Balmer lines of H, when produced by electron impact dissociative excitation of low pressure H_2, are much broader than the Doppler width of thermal H atoms. Indeed, they each have (a) a central peak and (b) broad wings, which result from two different groups of dissociative states. Excitation cross sections show structure as a function of electron energy. This helps to identify the states as follows: Predissociated and directly dissociated Rydberg states produce the central peaks and doubly excited states produce the wings. (auth)

24355 THE ENERGY DISTRIBUTIONS OF SECONDARY ELECTRONS FROM Ar, N_2, H_2O, AND H_2O WITH CLUSTERS PRESENT. Mathis, R.F.; Vroom, D.A. (IRT Corporation, San Diego, California 92138). J. Chem. Phys. 64: No. 3, 1146-1149 (1 Feb 1976).

Crossed beam measurements have been made of the energy spectra of secondary electrons resulting from collisions of 1 keV primary electrons with N_2, Ar, H_2O, and H_2O with clusters present. Only those electrons emitted normal to the primary beams were detected. A thorough description of the apparatus is given. (auth)

24356 NEGATIVE GASEOUS IONS FROM NITRIC ACID. Mathur, B.P.; Rothe, E.W.; Tang, S.Y.; Mahajan, K. (Research Institute for Engineering Sciences and Department of Chemical Engineering, Wayne State University, Detroit, Michigan 48202); Reck, G.P. J. Chem. Phys. 64: No. 3, 1247-1248 (1 Feb 1976).

A crossed-beam system of Cs atoms and HNO_3 molecules has been used to study the ion chemistry of HNO_3. The existence of an HNO_2^- anion was observed and $EA(HNO_3)$ and $D(H–ONO_2^-)$, the electron affinity of HNO_3, and the dissociation energy of the parent anion were measured. Also, value for $EA(NO_3)$ was deduced which requires additional thermodynamic data and it was compared with previous work. (AIP)

24357 ENERGY LOSS SPECTRA OF K^+ IONS (0.1–1.0 keV) IN COLLISION WITH N_2 MOLECULES. Inouye, H.; Niurao, K.; Sato, Y. (Research Institute for Scientific Measurements, Tohoku University, Sanjyo-machi, Sendai, Japan). J. Chem. Phys. 64: No. 3, 1250-1251 (1 Feb 1976).

The energy loss spectra of K^+ ions (E_0=0.1-1.0 keV) scattered by N_2 molecules is reported for the laboratory angle range of 1–18°. (AIP)

24358 COMMENT ON "INELASTIC SCATTERING IN ATOM–DIATOMIC MOLECULE COLLISIONS. I. ROTATIONAL

TRANSITIONS IN THE SUDDEN APPROXIMATION". Pack, R.T. (Department of Chemistry, Brigham Young University, Provo, Utah 84602). J. Chem. Phys. 64: No. 3, 1257-1258 (1 Feb 1976).

It is argued that conflicting approximations in a recent paper [J. R. Stallcop, J. Chem. Phys. 61, 5085 (1974)] render the resulting theory invalid. (AIP)

24359 REPLY TO "COMMENT ON INELASTIC SCATTERING IN ATOM–DIATOMIC MOLECULE COLLISIONS. I. ROTATIONAL TRANSITION IN THE SUDDEN APPROXIMATION". Stallcop, J.R. (NASA-Ames Research Center, Moffett Field, California 94035). J. Chem. Phys. 64: No. 3, 1258-1259 (1 Feb 1976).

A reply is made to the comments by Pack in the preceding Comment, and it is argued that the assumptions in the paper discussed [Stallcop, J. Chem. Phys. 61, 5085 (1974)] are valid. (AIP)

24360 HEAVY-ION EXCITATION OF AUTOIONIZATION STATES IN HELIUM. Burch, D. (Department of Physics, University of Washington, Seattle, Washington 98195); Bolger, J.E.; Schneider, D.; Moore, C.F. Phys. Rev. Lett. 36: No. 3, 166-167 (19 Jan 1976).

The autoionization spectrum of He produced by 3.0-MeV Cl^{2+} ions is compared with results from other heavy-ion collisions to indicate the relative importance of collision velocity and projectile nuclear charge on the double excitation mechanism. (auth)

24361 EVIDENCE FOR TWO-ELECTRON EXCITATION PRODUCING Li *K* VACANCIES IN SLOW Li^++He COLLISIONS. Stolterfoht, N.; Leithäuser, U. (Hahn-Meitner Institut für Kernforschung Berlin GmbH, Bereich Kern-und Strahlenphysik, 1 Berlin 39, Germany). Phys. Rev. Lett. 36: No. 4, 186-189 (26 Jan 1976).

Significant Li K excitation is observed in Li^++He collisions at incident energies as low as 6 keV. To interpret the results a multistep process is proposed including two-electron excitation in the quasi molecule formed during the collision. The importance of this process is discussed for heavier collision systems. (auth)

24362 RESONANCE CHARGE EXCHANGE OF INERT-GAS IONS IN THE ENERGY RANGE 200–4000 eV. Kikiani, B.I.; Saliya, Z.E.; Bagdasarova, I.B. (Tbilisi State University). Sov. Phys.—Tech. Phys. 20: No. 3, 364-367 (Mar 1975).

Effective resonance charge-exchange cross sections for inert-gas ions are measured in the energy range 200–4000 eV. The cross sections are determined by detecting slow ions and free electrons formed in single collisions of fast He^+, Ne^+, Ar^+, Kr^+, and Xe^+ ions with their "own" atoms (potential method[2]). Several improvements in this method are made for the purpose of applying it to the indicated energy range. The results of these investigations are compared with theoretically calculated findings[2,3] and with the findings of other experimental work. (auth)

24363 SCATTERING OF POTASSIUM AND SODIUM IONS BY ATOMS OF HELIUM, NEON, ARGON, AND XENON. Chigin', V.I. Sov. Phys.—Tech. Phys. 20: No. 3, 429-431 (Mar 1975).

The total cross section for scattering of potassium and sodium ions by atoms of He, Ne, Ar, Xe is measured as a function of ion energy in the range 5–600 eV for definite values of the minimum angles, and as a function of the aperture angle of the apparatus (0.015–0.35 rad) for a constant energy. The observed maxima are used to estimate the product of the potential well depth ϵ and the ion-atom equilibrium distance σ. The predominance of a polarization interaction between ions and atoms [$v(r) \sim r^{-4}$] is confirmed in the region of small energies. (auth)

24364 EFFECTIVE TOTAL ELECTRON-IMPACT IONIZATION CROSS SECTIONS FOR ALUMINUM, GALLIUM, INDIUM, AND THALLIUM. Shimon, L.L.; Nepiipov, É.I.; Zapesochnyi, I.P. (Uzhgorod State University). Sov. Phys.—Tech. Phys. 20: No. 3, 434-434 (Mar 1975).

Using crossed atom-electron beams, measurements were made of effective total ionization cross sections for four metals in the range 10—300 eV. (AIP).

Atomic Theory

Refer also to abstracts 24324 and 24335.

24365 (KFKI–75-55) ELECTRO-MAGNETIC ACTION OF A SYSTEM UPON ITSELF CALCULATED BY WAVE MECHANICS. Janossy, L. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 12p. (CONF-751087–1). Dep. NTIS (US Sales Only) $4.25.

From second conference on interaction of electrons with strong electromagnetic field; Budapest, Hungary (6 Oct 1975).

It is shown that the electromagnetic reaction of an atomic system upon itself can be treated by a straightforward wave-mechanical method. Apparent difficulties arise in treatments where the atomic nuclei are incorrectly considered as classical particles. No difficulties arise, however, if the atoms are treated by many-body wave-functions, where the nucleus is one of the bodies. As an application of the method the emission of a photon by an H-atom is discussed. (auth)

24366 (LA-tr-75-15) INTERPRETATION OF ROTATION–VIBRATION SPECTRA OF MOLECULES WITH TETRAHEDRAL OR OCTAHEDRAL SYMMETRY. Moret-Bailly, J. Translated from Cah. Phys.; No. 130/131, 237-314(1961). 109p. Dep. NTIS $5.50.

The study of rotation-vibration spectra of "spherical tops," molecules, whose main types are methane and sulfur hexafluoride, is presented. It is shown that the general theory of rotation-vibration spectra must be modified for the study of the "spherical tops." The theory of irreducible spherical tensors is generalized so it can be adapted to problems with no revolution symmetry. The general theory is particularized in the case of systems with cubic symmetry. The cubic tensors thus defined are used to write the development up to the third order of the rotation-vibration Hamiltonian of the spherical tops. The matrix elements of this Hamiltonian are calculated in a representation which yields a diagonal energy matrix with respect to the quantum index of orientation of the kinetic momentum in the molecule. The selection rules related to this quantum index are established. Formulas are presented which make it possible to calculate the energies of the three-fold degenerate fundamental transitions by a perturbation method. This theory is applied to the V_4 band of methane, and a satisfactory interpretation of the experimental results is obtained by a calculation brought as far as the third order, involving only seven constants. 44 refs, 13 tables, 4 figs. (GHT)

24367 (LA-tr-75-16) INTRODUCTION TO THE CALCULATION OF THE ROTATION–VIBRATION ENERGY OF MOLECULES WITH SPHERICAL SYMMETRY. Moret-Bailly, J. Translated from Cah. Phys.; No. 112, (1959). 26p. Dep. NTIS $4.00.

The calculation of the normal coordinates of XY_6 type molecules is presented and the anharmonic terms of the potential energy and the value of the interaction coefficients of the vibrations and the rotation are deduced from it. The results pertaining to XY_4 type molecules are recalled. (auth)

24368 STUDY OF CONTRAST AND ITS EFFECT ON THE MEASUREMENT OF THE SCATTERED INTENSITY AND GYRATION RADIUS IN HETEROGENEOUS MACROMOLECULE SYSTEMS. Cotton, J. P.; Benoit, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). J. Phys. (Paris); 36: No. 9, 905-910(Sep 1975). (In French)

The notion of contrast is important in small angle scattering experiments. This is particularly true for the neutron technique. This notion is expressed in terms of an effective scattering length and allows the experimental data for heterogeneous macromolecules dispersed in a solid or liquid matrix to be correctly interpreted. In particular the variation of the square of the apparent radius of gyration with the mean effective scattering length is discussed. (FR)

24369 KINETICS OF ATOMIC EXCITATION AND THE POLARIZATION OF LINE RADIATION FROM A NONEQUILIBRIUM PLASMA. Busygin, E. P.; Grigoryants, V. G. (Ioffe Physico-Technical Institute, Academy of Sciences of the USSR, Leningrad, USSR). pp 20 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The experimental results of studying the polarization of radiation from Knudsen discharge in a longitudinal magnetic field are presented. Angular distribution of the fast electrons trapped in a potential well is analyzed as well as their influence on the polarization. The effect of reabsorption of radiation in the magnetic field on the polarization is emphasized. (NL)

24370 DENSITY MATRIX IN THE OPEN SHELL THEORY. Mestechkin, M. M.; Whyman, G. E. (Inst. of Physical Chemistry Donetsk, USSR). Int. J. Quant. Chem.; 9: No. 5, 761-773(Sep 1975).

All the second-order density matrix spin components for the spin-projected Slater determinant are presented as expansions in direct products of powers of unprojected spin- and residual electron density matrices. Spin components of the second-order transition density matrices between spin-projected Slater determinants built of orthogonal orbitals are also obtained. (auth)

24371 SMOOTH INTERPOLATION, FOURIER TRANSFORMATION, AND TWO-CENTER OVERLAP INTEGRALS FOR NUMERICAL ATOMIC ORBITALS. Thulstrup, P. W. (Univ. of Florida, Gainesville). Int. J. Quant. Chem.; 9: No. 5, 789-795(Sep 1975).

A smooth interpolation method for the calculation of Fourier

transforms of numerical atomic orbitals is presented and the method is used to calculate two-center overlap integrals. Examples applying various definitions of smoothness are given. (auth)

24372 DENSITY FUNCTIONAL REPRESENTATION OF QUANTUM CHEMISTRY. II. Local Quantum Field Theories of Molecular Matter in Terms of the Charge Density Operator Do Not Work. Primas, H.; Schleicher, M. (Swiss Federal Inst. of Tech., Zurich). Int. J. Quant. Chem.; 9: No. 5, 855-870(Sep 1975).

A comprehensive review of the attempts to rephrase molecular quantum mechanics in terms of the particle density operator and the current density or phase density operator is given. All pertinent investigations which have come to attention suffer from severe mathematical inconsistencies and are not adequate to the few-body problem of quantum chemistry. The origin of the failure of these attempts is investigated, and it is shown that a realization of a local quantum field theory of molecular matter in terms of observables would presuppose the solution of many highly nontrivial mathematical problems. (auth)

24373 POPULATION DIFFERENCE OF TWO-LEVEL ATOMIC SYSTEM DUE TO A RUNNING PULSED FIELD. Nayfeh, M. H. (Oak Ridge National Lab., TN). J. Appl. Phys.; 46: No. 11, 4862-4864(Nov 1975).

The method of multiple scales is used to derive an expression for the population difference in an absorbing atomic system due to a running pulsed field. The main contribution to this expression comes from a quasisteady-state part which has the same functional form as the hole produced by a continuous running field, except that the saturation parameter contains the time dependence of the field. The expression includes also an oscillatory term and a quasisteady term, which decay with a rate that is equal to the inverse of the lifetime of the levels. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstracts 22882 and 24018.

24374 (ANL-Trans-1032) COOLING OF LONG TUBE SYSTEMS WITH SUPERFLUID HELIUM. Krafft, G. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Jun 1975. Translation of KFK-1786. 84p. Dep. NTIS $5.00.

Heat transport experiments with superfluid helium in pipes of 60 to 400 cm length and diameters between 0.3 and 1.0 cm show the existence of a critical heat flow density, when superfluidity breaks down and vaporization onset starts. The critical heat flux is mainly determined by the amount of superheating required for bubble formation. Assuming that nucleation occurs on the superfluid vortex lines or vortex rings, the measured values of superheat can be explained. (auth)

24375 (LA-6108-MS) SINGULARITY FITTING IN HYDRODYNAMICAL CALCULATIONS II. Richtmyer, R. D.; Lazarus, R. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-eng-36. 16p. Dep. NTIS $4.50.

This is the second report in a series on the development of techniques for the proper handling of singularities in fluid-dynamical calculations; the first was called Progress Report on the Shock-Fitting Project. This report contains six main results: derivation of a free-surface condition, which relates the acceleration of the surface with the gradient of the square of the sound speed just behind it; an accurate method for the early and middle stages of the development of a rarefaction wave, two orders of magnitude more accurate than a simple direct method used for comparison; the similarity theory of the collapsing free surface, where it is shown that there is a two-parameter family of self-similar solutions for gamma equals 3.9; the similarity theory for the outgoing shock, which takes into account the entropy increase; a "zooming" method for the study of the asymptotic behavior of solutions of the full initial boundary-value problem; comparison of two methods for determining the similarity parameter delta by zooming, which shows that the second method is preferred. Future reports in the series will contain discussions of the self-similar solutions for this problem, and for that of the collapsing shock, in more detail and for the full range (1, infinity) of gamma; the values of certain integrals related to neutronic and thermonuclear rates near collapse; and methods for fitting shocks, contact discontinuities, interfaces, and free surfaces in two-dimensional flows. (auth)

24376 (ORNL-tr-4098) EQUIPMENT FOR MAGNETOHYDRODYNAMIC STUDIES OF FREE NONSUBMERGED LIQUID METAL JETS. Dorofeev, V. Translated by M. Gerrard from Latv. PSR Zinat. Akad. Vestis; No. 2, 54-56(1967). 3p. Dep. NTIS $3.50.

The paper deals with the general scheme, construction and the experience of running the device with liquid tin jet. (auth)

24377 TWO-PHASE FLOW. Chapter 16. Lecocq, P. (Electricite de France, 75 – Paris. Direction de l'Equipement). pp 889-913 of Fluid Mechanics Applied to Equipment and Energy Problems. Hug, M. (ed.). Paris, France; Eyrolles (1975). (In French)

(Electricite de France, 75 – Paris. Direction des Etudes et Recherches).

Configurations most frequently involved in gas-liquid two-phase flow are defined. A qualitative classification in horizontal, vertical, and pulsed flow is used. A quantitative approach is then envisaged with the equations. (FR)

24378 THERMO-FLUID DYNAMIC THEORY OF TWO-PHASE FLOW. Ishii, M. Collection de la Direction des Etudes et Recherches d'Electricite de France. Paris, France; Eyrolles (1975). 248p.

A detailed discussion on the formulation of various mathematical models of two-phase flows based on the conservation laws of mass, momentum and energy is presented. Special emphases have been put on the local instant formulation and on the time-averaged macroscopic models. Two important models have been presented: (1) the two-fluid model which is formulated by considering each phase separately, and (2) the diffusion model which is formulated by considering the mixture as a whole, thus it is expressed in terms of three mixture conservation equations of mass, momentum and energy with one additional diffusion equation. The present formulation can be used to obtain the wall laws by analyses, i.e., the friction factors and heat transfer coefficients. The highlight of the report is the proposed constitutive laws with special emphasis on the interfacial exchange terms as well as on the turbulent transfer terms. (FR)

24379 FLOW STABILITY. Chapter 17. Lecocq, P. (Electricite de France, 75 – Paris. Direction de l'Equipement). pp 915-950 of Fluid Mechanics Applied to Equipment and Energy Problems. Hug, M. (ed.). Paris, France; Eyrolles (1975). (In French)

(Electricite de France, 75 – Paris. Direction des Etudes et Recherches).

Mathematical methods generally used in studying flow stability are presented. Monophasic flows are first considered: Poiseuille and Couette flow, flow around obstacles (transfer method). Two-phase flows are then considered: Ledinegg static instability, and dynamic instability (oscillations). The inadequacy of nonlinear methods is shown. (FR)

24380 SUPERFLUID PHASES OF ^{3}He IN A MAGNETIC FIELD. Carton, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). J. Phys. (Paris), Lett.; 36: No. 9, L.213-L.217(Sep 1975).

The behavior of superfluid ^{3}He in the presence of a magnetic field is discussed assuming an L = 1 pairing. In particular a new phase with a spatially nonuniform (sinusoidal) order parameter is predicted. These results are extended in order to take into account strong-coupling effects. Measurements under a magnetic field may provide information on the phenomenological Landau coefficients. (FR)

24381 RAY DISCONTINUITIES AND STRICT EXCEPTIONALITY IN RELATIVISTIC MAGNETOHYDRODYNAMICS. Greco, A. (Messina Univ. (Italy). Istituto di Matematica). Ann. Inst. Henri Poincare, Sect. A; 22: No. 3, 217-227(1975). (In French)

It is pointed out that it is not possible to give a definite covariant form for the disturbance of the rays if the waves are not exceptional; so for the sonic waves both in relativistic hydrodynamics (HRD) and in relativistic magnetohydrodynamics (MHDR). After this, the first order discontinuities and the shocks are examined in the completely exceptional case of an incompressible fluid and the conditions of strict exceptionality are given. (FR)

24382 EFFECT OF A UNIFORM MAGNETIC INDUCTION FIELD UPON THE FLOW OF AN ELECTRICALLY CONDUCTING FLUID PLACED IN A STRAIGHT RECTANGULAR CROSS SECTION, ONE OF THE WALLS OF WHICH, CHARACTERIZED BY AN INFINITE CONDUCTIVITY, PRESENTS UNIFORM TRANSLATION MOVEMENT. Herve, P. (Centre Universitaire de Saint-Denis, 974 – Reunion (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 1, 17-20(7 Jul 1975). (In French)

This is a theoretical study of an electrically viscous fluid flowing in a straight rectangular cross section channel, a wall of which, infinitely conducting, is placed perpendicularly to the direction of a uniform magnetic induction field. The three other walls of the channel being electrically insulating, remain motionless. Formulas giving velocity distribution law in the straight section of the flow in relation to the Hartmann's number, curves illustrating the accelerating effect produced across the whole section, by the application of the magnetic induction field, and example for the distribution of the electric current lines in case of a square section are given. (FR)

24383 HIGH-FREQUENCY PHONON TRANSMISSION BETWEEN A SOLID AND SUPERFLUID ^{4}He. Sluckin, T. J.; Sheard, F. W.; Bowley, R. M.; Toombs, G. A. (Nottingham Univ., Eng.). J. Phys., C (London); 8: No. 21, 3521-3530(7 Nov 1975).

The frequency dependence of phonon transmission through a solid-liquid ^{4}He interface is studied on the basis of a simple model of the solid-liquid coupling. For single-quantum processes the transmission coefficient is calculated using a T-matrix formalism and shows extremely sharp peaks, where the transmission probability becomes unity, at frequencies near the roton minimum and phonon maximum of the superfluid dispersion curve. Multi-excitation processes in the helium are also analysed but are found to be small. The conditions required for observation of transmission peaks are discussed with reference to recent experimental data on high-frequency phonon transmission and modifications of the model are proposed. (auth)

24384 BINDING ENERGY OF A ROTON PAIR IN He II. Latham, W. P.; Kobe, D. H. (North Texas State Univ., Denton). J. Phys., C (London); 8: No. 21, L461-L463(7 Nov 1975).

An apparent discrepancy between the binding energy of a roton pair determined by measuring the position of the peak in the light-scattering cross section and that determined by fitting the shape of the peak is resolved. By using a theory which includes

the finite lifetime of the bound roton pair, the peak shape is fitted with a binding energy of 0.37 K, which agrees with the peak position measurement. (auth)

24385 RAMAN SCATTERING FROM ROTONS AND PHONONS IN SUPERFLUID HELIUM. Woerner, R. L. (Massachusetts Inst. of Tech., Cambridge); Stephen, M. J. J. Phys., C (London); 8: No. 21, L464-L467(7 Nov 1975).

A theoretical expression is presented for the Raman scattering from interacting rotons and phonons in He^4. It is shown that the energy shift and zero-temperature linewidth of the scattering resonance are determined by both the roton-roton and the roton-phonon interactions. A contribution to the asymmetry in the scattered-light lineshape arises from the interference between the scattering amplitudes of rotons and phonons. The theoretical expression is fitted to the Raman data of Murray et al, and the interaction potentials are estimated. (auth)

24386 OBSERVATION OF TWO-DIMENSIONAL PLASMONS AND ELECTRON-RIPPLON SCATTERING IN A SHEET OF ELECTRONS ON LIQUID HELIUM. Grimes, C.C.; Adams, G. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 36: No. 3, 145-148 (19 Jan 1976).

The two-dimensional plasmon dispersion relation $\omega_p^2 = 2\pi Ne^2k/m$ has been verified in the classical one-component plasma formed by a sheet of electrons in image-potential-induced surface states on liquid helium. For temperatures below 0.68 K the plasmon damping indicates that the electron mobility is limited by electron-ripplon scattering. (auth)

24387 HELIUM II THERMAL COUNTERFLOW: TEMPERATURE- AND PRESSURE-DIFFERENCE DATA AND ANALYSIS IN TERMS OF THE VINEN THEORY. Childers, R.K.; Tough, J.T. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. B 13: No. 3, 1040-1055 (1 Feb 1976).

We report an extensive investigation of the temperature and pressure difference associated with the thermal counterflow of He II in long capillary tubes. For heat currents that are not too large, our temperature data are in excellent agreement with the Vinen theory in which mutual friction is regarded as arising from a homogeneous mass of quantized vortex line. Our pressure data, which are obtained simultaneously with the temperature data, are used to determine the eddy viscosity of the vortex lines. The Vinen theory is reviewed and somewhat modified in the light of these and other recent results. It is suggested that the vortex-line model of thermal counterflow is one of the few successful quantitative models of nonlinear hydrodynamics effects in He II. (auth)

24388 SOME CALCULATIONS REGARDING THE CHARACTERISTIC LENGTH FOR SUPERFLUIDITY IN LIQUID HELIUM. Chester, M. (Institut für Theoretische Physik, Freie Universität, Berlin); Eytel, L. Phys. Rev. B 13: No. 3, 1069-1076 (1 Feb 1976).

A superfluid characteristic length has consistently emerged from a variety of independent experiments on helium thin films. Both the magnitude and the temperature dependence of this quantity are now quite well defined within relatively narrow limits. This length appears to consist of two parts: the thickness of solid blanketing the substrate underneath the liquid film plus a pseudolength deriving from supplementary excitations in the system. The first contribution is directly calculated, and the results appear to fit experiment quite well. For the remaining pseudolength we estimate the parameters necessary for a surface-roton-excitation hypothesis to fit experiment. We find, using the analysis presented, that the quantitative features of a surface-excitation spectrum may be deduced with considerable precision from presently available experimental data. (auth)

24389 THEORY OF THE EXCITATION SPECTRUM OF LIQUID ^{4}He. Alberico, W.M. (Istituto di Fisica Teorica dell'Università di Torino, Torino, Italy); Kirson, M.W.; Molinari, A.; Broglia, R.A. Phys. Rev. B 13: No. 3, 1080-1085 (1 Feb 1976).

A critical review of the theory of a Bose liquid at $T = 0$ as given by Beliaev, Hugenholtz, and Pines and by Brueckner and Sawada is presented. An improved solution of Brueckner's nonlinear integral equation for the vertex functions is proposed. Such a solution is based on a proper parametrization of the angular-momentum dependence of the Green's function. The experimental excitation spectrum is very well reproduced by the theory in the range of linear momenta $0 < q < 2.3$ Å^{-1}. Remarkably, the calculated density is in exact accord with the experimental value. (auth)

24390 RAMAN SPECTRA FROM CONDENSED PHASES OF HELIUM. II. EXCITATION OF MORE THAN ONE PHONON. Surko, C.M.; Slusher, R.E. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 13: No. 3, 1095-1104 (1 Feb 1976).

We present Raman spectra for pure solid and liquid ^{3}He, ^{4}He, and ^{4}He$_x$ ^{3}He$_{1-x}$ solutions for frequency shifts from 10 to 300 K. The data for all phases show a broad peak. In the solids this peak corresponds reasonably well with the scattering expected from the phonons near the zone boundary. In the liquids a similar interpretation is possible although not compelling. The data from all phases also show a large amount of intensity beyond that corresponding to the maximum of twice a phonon frequency which has a monotonically decreasing dependence on frequency shift. The high-frequency tail extends out to 300 K in the higher density solids (17 cm^3/mole). This feature of the spectra, which is absent in classical solids, is found to correspond to a Raman process where a photon Raman scatters, producing a pair of energetic nearly-free particles with equal and opposite wave vector. The details of this model are explored both theoretically and experimentally. (auth)

24391 DISPERSION RELATION FOR PHONON SECOND-SOUND WAVES IN SUPERFLUID HELIUM. Benin, D. (Department of Physics, Arizona State University, Temple, Arizona 85281). Phys. Rev. B 1 No. 3, 1105-1111 (1 Feb 1976).

The velocity and attenuation of phonon second-sound waves in superfluid ^{4}He at saturated vapor pressure have been calculated, as a function of sound-wave frequency ω, over the entire frequency range at a single temperature 0.25 °K. Second sound is obtained as a wavelike normal mode of a model phonon Boltzmann equation containing, in addition to the lifetime $\tau_\parallel$ of a single thermal phonon due to small-angle scattering, a sequence of longer lifetimes characterizing wide-angle scattering of phonons with anomalous dispersion. The calculated second-sound phase velocity shows a dispersion spread out over four orders of magnitude in frequency in the range $\omega\tau_\parallel \lesssim 1$. Moreover, there is a wide frequency range satisfying $\omega\tau_\parallel \gg 1$ in which a second-sound collective mode still propagates, with the same velocity as a thermal phonon but with an attenuation length much longer than the thermal-phonon mean free path. The existence of a collective mode in the regime $\omega\tau_\parallel \gg 1$, due to small-angle scattering, supports Maris's proposed explanation of resonancelike dispersion in the first-sound velocity, and also implies that the transition from collective to ballistic propagation in heat-pulse experiments is more complicated than previously supposed. (auth)

24392 ANGULAR MOMENTUM AND ORBITAL WAVES IN THE ANISOTROPIC *A* PHASE OF SUPERFLUID He^3. Volovik, G.E. (L. B. Landau Institute of Theoretical Physics, USSR Academy of Sciences). JETP Lett. 22: No. 4, 108-109 (20 Aug 1975).

The angular-momentum density of He^3 in the *A* phase is calculated. Equations for the orbital waves are derived on the basis of the commutation relations for the components of the angular momentum. The effective mass of the orbital excitations turns out to be of the order of $m\,(T_c/\epsilon_f)^2\ln(\epsilon_f/T_c)$. (auth)

24393 SPIN DIFFUSION COEFFICIENT OF THE A AND B PHASES OF LIQUID ^{3}He. Shahzamanian, M. A. (Univ. of Sussex, Brighton, Eng.). J. Low Temp. Phys.; 22: No. 1/2, 27-37 (Jan 1976).

The spin diffusion coefficient tensors are calculated in the A and B phases of liquid ^{3}He in the omega/sub L/tau/sub D/ less than 1 regime by using the Kubo formula approach. The spin wave dispersions are also obtained in the presence of diffusive flow of the normal component. The results agree with Combescot's results qualitatively in the omega/sub L/tau/sub D/ less than 1 regime. (auth)

24394 KINETIC THEORY OF ANISOTROPIC FERMI SUPERFLUIDS. Woelfle, P. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). J. Low Temp. Phys.; 22: No. 1/2, 157-183 (Jan 1976).

A kinetic theory of anisotropic Fermi superfluids is presented. The kinetic equation for the quasiparticle matrix distribution function is derived from the microscopic theory, supplemented by definitions of the relevant densities and currents. The static spin susceptibility, the normal fluid density, and the specific heat are calculated from the static limit of the kinetic equation. Special attention is given to the collision integral, which is presented explicitly in terms of normal Fermi liquid quantities. The energy dependence of the collision integral makes necessary the introduction of two other distribution function matrices, for which kinetic equations are also derived. (auth)

24395 THIN-FILM PROFILE ON A HETEROGENEOUS SURFACE. Cole, M. W. (Pennsylvania State Univ., University Park); Vittoratos, E. J. Low Temp. Phys.; 22: No. 1/2, 223-230 (Jan 1976).

The shape of the interface between vapor and a physisorbed film on a substrate composed of two media is derived. This represents a simple example of adsorption on a heterogeneous surface. The results are explained in terms of competition between the surface energy and potential energy due to the substrate. Applications to superfluid onset and third sound attenuation are considered. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 23921, 24441, and 24445.

24396 PION CLOUD SYSTEM. Larson, G. P. Madison, WI; Univ. of Wisconsin (1975). 114p. University Microfilms Order No. 75-23,853.

Thesis (Ph. D.).

The multiparticle Argo spectrometer system is a unique experimental apparatus which combines two good resolution, particle identifying, moveable spectrometer arms with a multiparticle-momentum detecting vertex spectrometer. With data obtained by this device, an analysis is carried out which allows one to obtain a system relatively free of final state leading particle influences. The resulting system, which is referred to as the Pion Cloud System or P.C.S., exhibits a strong tendency towards mass (particle) and energy distribution isotropy, two important qualifications for a statistically dominated system. Although statistical multiparticle production models were predicated on the existence of such a system for the past 20 years or so, this is the first reasonably straight forward experimental observation of it. Specific characteristics of the P.C.S. are also studied. An apparent lack of angular momentum in the cloud could be construed as consistent with its production resulting from point like quark/parton interactions. Its apparent statistical nature motivates one to fit various statistical distribution functions to cloud momentum distributions, obtaining a characteristic cloud temperature of kT approximately 130 MeV. The charge multiplicity of the cloud is observed to vary linearly with its mass, consistent with simple statistical fireball models. Relative topological cross sections show no significant low mass (less than 1 GeV/c^2) resonances. In particular, a search for rho^0 yields pi$^+$pi$^-$ using various cloud momentum cuts results in no distinct signal observation. Cloud multiplicity variation is seen to be roughly Poisson as in statistical independent particle production models and multiperipheral models. The cross section for the observed cloud data is estimated to be approximately 1 mb. (Diss. Abstr. Int., B)

Electromagnetic

Refer also to abstract 24443.

24397 (DESY-75/41) ELECTROPRODUCTION OF NEUTRAL PIONS IN THE RESONANCE REGION. Alder, J. C.; Brasse, F. W.; Fehrenbach, W.; Gayler, J.; Goel, S. P.; Haidan, R.; Korbel, V.; May, J.; Merkwitz, M.; Nurimba, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1975. 20p. Dep. NTIS (US Sales Only) $3.50.

Results on the reaction $ep \rightarrow e'p\pi^0$ are presented in the mass range $1.355 \leq W \leq 1.745$ GeV at $q^2 \sim 1$ GeV^2 and in the range $1.415 \leq W \leq 1.595$ GeV at $q^2 \sim 0.6$ GeV^2. From the angular distribution of the π^0 meson polarization terms have been determined in a range of production angles from 50° up to 180°. Results on the total $\gamma_v p \rightarrow \pi^0 p$ cross section are given. 8 figures, 2 tables. (auth)

24398 (DESY-75/42) SEARCH FOR NARROW RESONANCES IN THE REACTION $\gamma + Be \rightarrow e^+e^- + X$ AT $1.8 \leq M_{e^+e^-} \leq 2.6$ GeV. Brauel, P.; Canzler, T.; Cords, D.; Felst, R.; Grindhammer, G.; Kollmann, W. D.; Krehbiel, H.; Schaedlich, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1975. 12p. Dep. NTIS (US Sales Only) $3.50.

The reaction $\gamma + Be \rightarrow e^+e^- + X$ was studied with a bremsstrahlung beam of 7.2 GeV maximum energy. For invariant pair masses $1.8 \leq M_{e^+e^-} \leq 2.6$ GeV, no evidence for narrow resonances of width smaller than 40 MeV was found. For the mass interval $2.1 \leq M_{e^+e^-} \leq 2.6$ GeV, an upper limit of the cross section times the e^+e^- branching ratio $< 2 \cdot 10^{-35}$cm^2 (90% confidence level) was obtained, assuming a production mechanism similar to the ϕ (1019) meson. 3 figures, 1 table. (auth)

24399 (KFK-2209) PHOTOPRODUCTION OF PHI MESONS AT SMALL MOMENTUM TRANSFERS. Hirschmann, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Sep 1975. 125p. (In German). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Univ., Karlsruhe, Ger.

The photoproduction of Φ-mesons was investigated in the elastic reaction $\gamma p \rightarrow \Phi p \rightarrow K^+K^-p$ collecting a comparatively large number of data. The differential cross section $((d\sigma/dt)_{\gamma p \rightarrow \Phi p}(E,t))$ is determined for various intervals of the four-momentum transfer (t) from the photon to the proton and for photon energies (E) within the range $0 < |t-t_{min}| < 0.23$ GeV^2 $4.6 < E < 6.62$ GeV. The Φ-meson is detected from the four-momenta of its decay products K^+ and K^-. (auth)

24400 MEASUREMENTS OF THRESHOLD π^+ ELECTROPRODUCTION AT LOW MOMENTUM TRANSFER. Del Guerra, A.; Giazotto, A.; Giorgi, M. A.; Stefanini, A. (Pisa Univ. (Italy). Instituto di Fisica); Botterill, D. R.; Braben, D. W.; Clarke, D.; Norton, P. R. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Phys., B; 99: No. 2, 253-286(24 Nov 1975).

The reaction $e^- + p \rightarrow e^- + \pi^+ + n$ has been studied near threshold at momentum transfers mod(k^2) of 0.078, 0.155, 0.233 and 0.311 (GeV=c)^2. The slope of the total cross section evaluated at threshold has been compared with models based on PCAC and current algebra to deduce the axial vector form factor of the nucleon, $G_A(k^2)$. In the dipole parametrisation $G_A(k^2)/G_A(0) = (1 + \text{mod}(k^2)/M_A^2)^{-2}$ it is found that the models give values of M_A ranging between 1.0 and 1.2 GeV. The π^+n angular distributions are compared with fixed-t dispersion relations and with a pseudovector Born approximation and are found to be in good agreement. (NL)

24401 ANTIPROTON CROSS SECTIONS IN A CONTINUUM OF ENERGY. Laloum, M. (College de France, 75 – Paris). Nucl. Instrum. Methods; 128: No. 3, 589-591(15 Oct 1975).

A simple and quite accurate method is proposed allowing a continuous energy-dependent normalization of antiproton cross sections, down to the immediate vicinity of stop-point. (NL)

24402 MEASUREMENT OF THE TARGET ASYMMETRY FOR THE REACTION γp(SPIN UP) $\rightarrow \pi^+ n$ AT PHOTON ENERGIES BETWEEN 0.7 AND 2.2 GeV AND A PION cm-ANGLE OF 65°. Althoff, K. H.; Conrad, R.; Herr, H.; Hilger, E.; Kadansky, V.; Kaul, O.; Menze, D.; Meyer, W.; Miczaika, T. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Phys. Lett., B; 59: No. 1, 93-94(13 Oct 1975).

At the Bonn 2.5 GeV electron synchrotron the target asymmetry for the photoproduction of positive pions has been measured. Data were taken at photon energies between 0.7 and 2.2 GeV and a pion CM-angle of 65°. (NL)

24403 ELECTROPRODUCTION OF π^+ MESONS IN THE RESONANCE REGION. Alder, J. C.; Behrens, H.; Brasse, F. W.; Fehrenbach, W.; Gayler, J.; Goel, S. P.; Haidan, R.; Korbel, V.; May, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Phys., B; 99: No. 1, 1-12 (17 Nov 1975).

Results on the reaction $ep \rightarrow e'n\pi^+$ are presented in the mass range $1.355 \leq W \leq 1.775$ GeV at $q^2 = 1$ GeV^2 and in the range $1.415 \leq W \leq 1.595$ GeV at $q^2 = 0.6$ GeV^2. From the angular distribution of the π^+ meson the polarization terms have been determined in the range of production angles $0 < \theta^*$ sub(π^+) < approximately 63°. (NL)

24404 SEARCH FOR NEW RESONANCES AND THRESHOLDS IN INELASTIC ELECTRON SCATTERING. Cottrell, R.L.A.; Ash, W.; Atwood, W.B.; Coward, D.H.; DeStaebler, H.; Mestayer, M.; Pessard, H.; Prescott, C.Y.; Rochester, L.S.; Sherden, D.J.; Sinclair, C.K.; Taylor, R.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94306). Phys. Rev. D 13: No. 1, 166-170 (1 Jan 1976).

We have extended the search for new resonances and thresholds in the hadronic final state X^+ in $ep \rightarrow eX$ for missing masses from 3 GeV to 5.5 GeV. At a level of roughly 5% of the cross sections we found no unexpected structure. (auth)

24405 DETERMINATION OF THE PION FORM FACTOR UP TO $Q^2 = 4$ GeV^2 FROM SINGLE-CHARGED-PION ELECTROPRODUCTION. Bebek, C.J.; Brown, C.N.; Herzlinger, M.; Holmes, S.D.; Lichtenstein, C.A.; Pipkin, F.M.; Raither, S.; Sisterson, L.K. (Cyclotron Laboratory, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 13: No. 1, 25-42 (1 Jan 1976).

We report new measurements of the electroproduction of single charged pions hydrogen and deuterium targets carried out at the Wilson Synchrotron at Cornell University. Measurements were made at the (W, Q^2) points (2.15 GeV, 1.2 GeV^2), (2.15, 4.0), and (3.11, 1.2) with hydrogen and deuterium and at (2.15, 2.0), (2.67, 3.4), and (3.11, 1.7) with only hydrogen. The deuterium data were used to determine the ratio of the cross sections for the reactions $\gamma vd \rightarrow \pi^+ nn$, and $\gamma vd \rightarrow \pi^-$

pp, and thus to measure the isoscalar contribution to the reaction $\gamma n p \rightarrow \pi^+ n$. The data are consistent with the hypothesis that this ratio is a universal function of the momentum transfer. The measured ratio was used to determine from the hydrogen data and the data taken in earlier experiments the isovector component of the cross section. The dispersion theory formulated by Berends was then used to determine from the isovector component the pion form factor in the Q^2 range from 0.2 to 4.0 GeV^2. A simple pole expression of the form $[1 + Q^2/(0.471 \pm 0.010)]^{-1}$ gives a good fit to the data. (auth)

24406 MEASUREMENT OF THE REACTION $e^+e^- \rightarrow \gamma\gamma$ IN THE REGION OF THE ψ (3684). Hughes, E.B.; Beron, B.L.; Carrington, R.L.; Ford, R.L.; Hilger, E.; Hofstadter, R.; Liberman, A.D.; Martin, T.W.; O'Neill, L.H.; Simpson, J.W. (High Energy Physics Laboratory and Department of Physics, Stanford University, Stanford, California 94305); Resvanis, L.K. Phys. Rev. Lett. 36: No. 2, 76-79 (12 Jan 1976).

In a study of the reaction $e^+e^- \rightarrow \gamma\gamma\gamma$ in the region of the ψ (3684) resonance, no evidence is found for a deviation from quantum electrodynamics. Limits are also set on the decays ψ (3684) $\rightarrow \pi^0\gamma$, ψ (3684) $\rightarrow \eta^0\gamma$, and ψ (3684) $\rightarrow X^0\gamma$, where X^0 is a pseudoscalar state in the mass range 2500–3000 MeV which subsequently decays into two γ rays. (auth)

Weak

Refer also to abstract 24515.

24407 (CONF-7409140-P1, pp 177-202) WEAK CURRENTS. Cabibbo, N. (Instituto Superiore di Sanita, Rome). 1974. (In French and English)

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In weak interactions. Vol. I.

The essential knowledge on the structure of the weak hadronic current is presented. A particular attempt is made to clarify the physical significance of various hypotheses, such as CVC, PCAC, SU(3), and the angle θ, chiral algebra, which have marked the progress of the comprehension of weak interactions. Included are complete and phenomenological theory, currents and symmetries of hadrons, CVC the conserved vector current, verification of CVC, introduction to SU(3), SU(3) and weak currents, and chiral algebra, PCAC and all that. (JFP)

24408 (CONF-7409140-P1, pp 203-270) REVIEW OF THE EXPERIMENTAL SITUATION FOR WEAK INTERACTIONS. Turlay, R. (CEN, Saclay, France). 1974. (In French)

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In weak interactions. Vol. I.

The review of the experimental status of weak interactions includes a general review of $\Delta S = 1$ neutral current suppression, the $\Delta T = \frac{1}{2}$ rule in the study of $K \rightarrow 3\pi$ decay, the $\Delta S = \Delta Q$ rule, and hyperon leptonic decay. (JFP)

24409 (CONF-7409140-P1, pp 325-373) NEUTRINO INTERACTIONS AT ANL, BNL, AND CERN. Musset, P. (CERN, Geneva). 1974.

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In weak interactions. Vol. I.

The discussion of neutrino interactions includes experimental techniques, and experimental results for $\Delta Q = 1$, and 0 reactions. (JFP)

24410 HADRON-QUARK RECIPROCITY AND MULTIPLICITIES IN ELECTROPRODUCTION AND ANNIHILATION FROM THE QUARK–PARTON MODEL. Fetzer, D. C.; Schlereth, H. (Technische Hochschule, Aachen). Nuovo Cim.; 31A: No. 1, 65-78 (1 Jan 1976).

Hadron-quark reciprocity together with an available fit of the quark-parton distribution functions from electroproduction is used to derive detailed predictions for multiplicities and average multiplicities for electroproduction and annihilation inclusive processes with one nucleon detected in the final state. (auth)

24411 STUDY OF THE ISOSPIN PROPERTIES OF SINGLE-PION PRODUCTION BY NEUTRINOS. Barish, S.J.; Cho, Y.; Derrick, M.; Dombeck, T.; Hyman, L.G.; Musgrave, B.; Schreiner, P.; Singer, R.; Smith, R.P.; Swanson, D.; Yuta, H. (Argonne National Laboratory, Argonne, Illinois 60439); Barnes, V.E.; Carmony, D.D.; Garfinkel, A.F. Phys. Rev. Lett. 36: No. 4, 179-183 (26 Jan 1976).

Results are presented on the three single-pion production reactions $\nu p \rightarrow \mu^- p\pi^+$, $\nu n \rightarrow \mu^- n\pi^+$, and $\nu n \rightarrow \mu^- p\pi^0$. Measurements were made from threshold to a neutrino energy of 1.5 GeV using the Argonne National Laboratory 12-ft bubble chamber filled with hydrogen and deuterium and exposed to a broad-band neutrino beam. In addition to a resonant isospin $T=3/2\pi N$ amplitude, we find a large $T=1/2$ amplitude as predicted by Adler. (auth)

24412 MULTIPLICITY DISTRIBUTIONS IN HIGH-ENERGY NEUTRINO INTERACTIONS. Chapman, J.W.; Coffin, C.T.; Diamond, R.N.; French, H.; Louis, W.; Roe, B.P.; Seidl, A.A.; Vander Velde, J.C. (University of Michigan, Ann Arbor, Michigan 48104); Berge, J.P.; Bogert, D.V.; DiBianca, F.A.; Cundy, D.C.; Dunaitsev, A.; Efremenko, V.; Ermolov, P.; Fowler, W.; Hanft, R.; Harigel, G.; Huson, F.R.; Kolganov, V.; Mukhin, A.; Nezrick, F.A.; Rjabov, Y.; Scott, W.G.; Smart, W. Phys. Rev. Lett. 36: No. 3, 124-126 (19 Jan 1976).

We present results from the Fermilab 15-ft bubble chamber on the charged-particle multiplicity distributions produced in high-energy charged-current neutrino-proton interactions. Comparisons are made to γp, ep, μp, and inclusive pp scattering. The mean hadronic multiplicity $\langle n_c \rangle$ appears to depend only on the mass of the excited hadronic state, independent of the mode of excitation. A fit to the neutrino data gives $\langle n_c \rangle = (1.09 \pm 0.38) + (1.09 \pm 0.03) \ln W^2$. (auth)

24413 INCLUSIVE STRANGE-PARTICLE PRODUCTION BY νp INTERACTIONS IN THE 10–200-GeV REGION. Berge, J.P.; Bogert, D.; Cundy, D.C.; DiBianca, F.A.; Dunaitsev, A.; Efremenko, V.; Ermolov, P.; Fowler, W.; Hanft, R.; Harigel, G.; Huson, F.R.; Kolganov, V.; Mukhin, A.; Nezrick, F.A.; Rjabov, Y.; Scott, W.G.; Smart, W. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Coffin, C.T.; Diamond, R.N.; French, H.; Louis, W.; Roe, B.P.; Seidl, A.A.; Vander Velde, J.C. Phys. Rev. Lett. 36: No. 3, 127-129 (19 Jan 1976).

Data are presented on charged-current inclusive strange-particle production in 10–200-GeV/c νp interactions. Final states with V^0 decay topologies are reported: K_s^0, $\Lambda^0(\Sigma^0)$, $\bar{\Lambda}^0(\bar{\Sigma}^0)$. Neutrino energy, charged multiplicity, Q^2, W, x, and y distributions are shown. The corrected relative V^0 production rate is 0.16 ± 0.03 per event. The first example of neutrino-induced antibaryon ($\bar{\Lambda}$) production is observed. The 90%-confidence upper limit on $\Delta S = -\Delta Q$ inclusive Λ production is 0.036 of all charged-current νp interactions above 10 GeV/c. (auth)

Strong (Baryon-induced)

Refer also to abstract 24536.

24414 (CONF-741181-P1, pp 63-102) HIGH ENERGY BEHAVIOR OF HADRON–NUCLEON CROSS SECTIONS. Ganguli, S. N. (Tata Inst. of Fundamental Research, Bombay). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

The review of the behavior of the hadron–nucleon cross sections includes results on total cross sections from accelerators, results from elastic scattering experiments, phenomenological framework for the total cross section, and results from cosmic ray experiments. (JFP)

24415 (CRN/HE-75-11) PRELIMINARY RESULTS ON LOW MULTIPLICITY pd AND π^+d INTERACTIONS AT 200 GeV/c. Braun, H.; Brick, D.; Eisenberg, Y. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires; Weizmann Inst. of Science, Rehovoth (Israel)). 1975. 14p. Dep. NTIS (US Sales Only) $3.50.

Preliminary results are presented on the low multiplicity events obtained from π^+d and pd interactions at 200 GeV/c. The data came from a 50,000 photographs exposure carried out at the Fermilab with the 30 inch deuterium filled bubble chamber and the Proportional Wire Hybrid system. 6 figures, 1 table. (auth)

24416 REACTION ANTI pp → ANTI p $\pi^-\pi^+$p AT 25 AND 40 GeV/c. Antipov, Yu. M.; Landsberg, L. G.; Lebedev, A. A.; Yotch, F. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij); Ascoli, G.; Sard, R. D.; Snyder, A. (Illinois Univ., Urbana (USA)); Baud, R.; Busnello, R.; Kienzle-Focacci, M. N. Nucl. Phys., B; 99: No. 2, 189-210(24 Nov 1975).

The reaction antipp → antip$\pi^-\pi^+$p has been studied at 25 and 40 GeV/c at the Serpukhov proton synchroton using the CERN-IHEP spectrometer. The differential cross section has been determined as a function of four-momentum transfer to the proton (0.05–0.30 (GeV/c)^2) and anti p$\pi\pi$ mass (up to 2.2 and 2.6 GeV/c^2). At both energies there is a broad low-mass maximum with an enhancement at 1.6–1.8 GeV/c^2. The cross section in a given mass band falls rapidly with mod(t), with an exponential slope that decreases with increasing mass. In both the background and the 1.7 GeV/c^2 peak there is a strong anti Δ–π^+ component. Possible spin-parity (J_P) contributions to it are discussed. Throughout the range 1.5–2.2 GeV there is at least one state of $J \geq \frac{3}{2}$ and there is interference between states of opposite P,

mod(ΔJ) ≤ 1. At the peak there is a $J \geq 5/2$ component. There are striking parallels between this reaction and the boson reactions $\pi^- p \rightarrow \pi^-\pi^-\pi^+ p$ and $K^- \rightarrow K^-\pi^-\pi^+ p$. (NL)

24417 DEUTERON BEAM FOR STUDYING THE dp INTERACTIONS. Aladashvili, B. S.; Glagolev, V. V.; Lebedev, R. M.; Nioradze, M. S.; Saitov, I. S.; Streltsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)); Badelek, B. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej); Nassalski, J.; Sandacz, A.; Siemiarczuk, T. Nucl. Instrum. Methods; 129: No. 1, 109-117 (1 Nov 1975).

The advantage is discussed of using the deuteron beam for studying dp reactions. The system of data analysis in the dp experiment at 3.3 GeV/c is described. The cross sections for the most frequent channels are presented. (NL)

24418 MULTI-π^0 EXPERIMENTS: AN ERROR ANALYSIS. Price, L. R. (California Univ., Irvine (USA). Dept. of Physics). Nucl. Instrum. Methods; 129: No. 1, 199-205(1 Nov 1975).

It is well known that the number of π^0s in a sample of events may be determined by detecting the resulting γ-ray conversions. Using a simple model, a formula is derived for the uncertainty in the total number of π^0s as a function of their total number and the gamma-ray conversion efficiency, epsilon sub(γ). Data for the reaction anti pp $\rightarrow$ pions at 1 GeV/c are simulated and analyzed; results agree with the above model. δf_1^0, δf_2^0, and δf_3^0 as functions of ϵ_γ are also determined from the simulated data. It is interesting that conventional hydrogen and deuterium bubble chamber experiments ($\epsilon_\gamma \sim 0.01$) containing large numbers of events could compete favorably with smaller (e.g., $\sim 1/3$ the number of events) experiments having $\epsilon_\gamma \geq 0.3$, as far as small δf_1^0 and δf_2^0 are concerned. For minimal uncertainty in f_3^0 (and higher moments), however, experiments with $\epsilon_\gamma \geq 0.2$ will be required. (NL)

24419 TEST OF THE ZWEIG SELECTION RULE IN PHI PRODUCTION BY pp COLLISIONS. Blobel, V.; Fesefeldt, H.; Jetter, Ch.; Neumann, H.; Soding, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Franz, H. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)); Hofmann, A.; Schroder, B. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Phys. Lett., B; 59: No. 1, 88-92(13 Oct 1975).

Φ production is studied in pp collisions at 24 GeV/c and compared with ρ^0, ω and K^* production. The relative suppression of the Φ is in qualitative accord with its coupling to nonstrange states. No tendency is observed for the final states to contain strange particles in conjunction with the Φ. (NL)

24420 MEASUREMENT OF TWO-PARTICLE SEMI-INCLUSIVE RAPIDITY DISTRIBUTIONS AT THE CERN ISR. Amendolia, S. R. (Univ., Pisa, Italy); Bellettini, G.; Bosisio, L. Nuovo Cim., 31A: No. 1, 17-53(1 Jan 1976).

Data on the semi-inclusive distributions of rapidities of secondary particles produced in pp collisions at very high energies are presented. The experiment was performed at the CERN Intersecting Storage Rings (ISR). The data given, at center-of-mass energies of $\sqrt{s}$ = 23 and 62 GeV, include the single-particle distributions and two-particle correlations. The semi-inclusive correlations show pronounced short-range correlation effects which have a width considerably narrower than in the case of inclusive correlations. It is shown that these short-range effects can be understood empirically in terms of three parameters whose energy and multiplicity dependence are studied. The data support the picture of multiparticle production in which clusters of small multiplicity and small dispersion are emitted with subsequent decay into hadrons. (auth)

24421 PROCEEDINGS OF THE TENTH RECONTRE DE MORIOND. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975). 406p. (CONF-750309-P1).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975).

Separate abstracts were prepared for the 31 papers presented. (JFP)

For abstracts of individual papers see: 24422-24426, 24458, 24459, 24526, 24543-24547, 24555-24557, 24567, 24568, 24582-24589, and 24612-24616.

24422 DIFFRACTIVE PRODUCTION OF THE $p\pi^+\pi^-$ SYSTEM AT THE ISR. Strolin, P. (CERN, Geneva). pp 47-58 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

The results obtained in a series of experiments at the CERN ISR, where a multiparticle forward spectrometer equipped with multiwire proportional chambers has been used to study diffractive production of the $p\pi^+\pi^-$ system, are reported. Resonant structures in the invariant mass distribution of this system were observed and cross sections for nucleon resonance production at ISR energies were measured. (auth)

24423 EXPERIMENTAL RESULTS ON LARGE ANGLE ELASTIC pp SCATTERING AT THE CERN ISR. Nagy, E. (CERN, Geneva). pp 75-84 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

New experimental results are presented on proton-proton elastic scattering at center-of-mass energies $\sqrt{s}$ = 23 GeV and $\sqrt{s}$ = 62 GeV. The data are obtained using the Split-Field-Magnet detector at the CERN Intersecting Storage Rings (ISR). The differential cross sections show an energy dependent behavior: the pronounced diffraction minimum at $t \approx -1.3$ GeV^2 is moving inwards with increasing energy and the cross section at the second maximum is increasing with $\sqrt{s}$. (auth)

24424 p-p SCATTERING-AMPLITUDE MEASUREMENTS WITH POLARIZED BEAMS AND POLARIZED TARGETS AT 2 TO 6 GeV/c. Yokosawa, A. (Argonne National Lab., IL). pp 161-166 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Measurements taken thus far for pp scattering amplitude measurements at 2 to 6 GeV/c include differential cross sections and the polarization parameter. (JFP)

24425 RESULTS ON INCLUSIVE CHARGED PARTICLE PRODUCTION IN THE CENTRAL REGION AT THE CERN ISR. Jarlskog, G. (CERN, Geneva). pp 203-217 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

An over-all description is given of data on inclusive production of $\pi^\pm$, $K^\pm$, p, and $\bar{p}$ collected at the CERN Intersecting Storage Rings (ISR). The kinematical range covered is $23 < \sqrt{s} < 63$ GeV, $0.1 < p_T < 5.0$ GeV/c, and $30 < \theta_{cm} < 90°$. The larger p_T data are compared with the prediction of the constituent interchange model, and a qualitative agreement is found. (auth)

24426 SEMINCLUSIVE CORRELATIONS AT THE ISR AND CLUSTER INTERPRETATION OF RESULTS. Menzione, A. (Istituto Nazionale de Fisica Nucleare, Pisa, Italy). pp 235-244 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Final results from the Pisa-StonyBrook ISR experiment on two-particle correlations at fixed charged multiplicity are shown. Positive, very short range correlations are found at all multiplicities. The data were interpreted in the language of the independent cluster emission model. It is shown that the average cluster multiplicity <k> depends smoothly on the energy and on the event multiplicity n. Scaling of <k> as function of n/<n> was also found. (auth)

24427 POLARIZATION IN *p-p* ELASTIC SCATTERING AT LARGE FOUR-MOMENTUM TRANSFERS. Bryant, G.W.; Corcoran, M.; Crittenden, R.R.; Gray, S.W.; Heinz, R.M.; Neal, H.A.; Rust, D.R. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 13: No. 1, 1-4 (1 Jan 1976).

New results are presented from the continuation of an experiment designed to study the polarization in elastic *p-p* scattering at large four-momentum transfers. A high-intensity unpolarized proton beam of momentum 12.3 GeV/*c* was incident on a propanediol polarized proton target and both final-state protons were detected and momentum-analyzed in multiwire proportional chamber spectrometers. The measurements spanned the *t* range $1.5 < |t| < 6.2$ (GeV/*c*)^2. The results are discussed in the framework of optical, exchange, and parton models. (auth)

24428 $\phi(1020) \rightarrow \rho(770)\pi$ DECAY. Kalbfleisch, G.R.; Strand, R.C. (Brookhaven National Laboratory, Upton, New York 11973); Chapman, J.W. Phys. Rev. D 13: No. 1, 22-24 (1 Jan 1976).

The ϕ (1020) $\rightarrow 3\pi$ decay appears to be dominated by $\rho\pi$ final states. (auth)

Strong (Meson-induced)

24429 (RL-75-159) PARTIAL WAVE ANALYSIS OF THE $(3\pi)^0$ SYSTEM FROM THE CHARGE EXCHANGE REACTION $\pi^+n \rightarrow \pi^+\pi^-\pi^0p$ AT 4 GeV/c. Emms, M. J.; Bell, I. G.; Charlesworth, J. A. (Birmingham Univ. (UK); Durham Univ. (UK); Science Research Council, Chilton (UK). Rutherford Lab.). Oct 1975. 14p. Dep. NTIS (US Sales Only) $3.50.

From a partial wave analysis of the $(3\pi)^0$ state in the charge exchange reaction $\pi^+n \rightarrow \pi^+\pi^-\pi^0p$, strong unnatural parity as well as natural parity production are observed. The observed natural parity states are identified with well-established resonances. The unnatural parity production is consistent with Reggeized Deck model predictions, with the exception of the I = 1 $J^P = 1^+$ state. Here there is no evidence for A_1 production at ~ 1.1 GeV, but the data could support resonance production at higher masses. (auth)

24430 INCLUSIVE AND SEMI-INCLUSIVE ρ^0 PRODUCTION IN π^-p INTERACTIONS AT 15 GeV/c. Brau, J.; Brick, D. H.; Grunhaus, J.; Hafen, E. S.; Hodous, M. F.; Hulsizer, R. I.; Karshon, U.; Kistiakowsky, V.; Levy, A.; Miller, P. A. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Phys., B; 99: No. 2, 232-252(24 Nov 1975).

An inclusive study has been done of ρ^0 production in π^-p interactions at 15 GeV/c. Evidence for two different production mechanisms, in addition to the known quasi two-body processes, is presented; production of ρ^0's in the central region of rapidity similar to the "polarization" region seen in the inclusive studies of pions; and forward production in the beam dissociation region of rapidity. Cross sections and rapidity distributions for the ρ^0 are given inclusively and by topology, and the results are compared with similar studies at other energies and with other incident particles. Results are also presented for the semi-inclusive reaction $\pi^-p \rightarrow \rho^0 + X^-$ and the exclusive final state $p\pi^-\rho^0$. (NL)

24431 STUDY OF THE REACTION $K^+n \rightarrow K^+\pi^-p$ AT 2-3 GeV/c. Baker, S. L.; Banerjee, S.; Campbell, J. R.; Islam, A. K. M. A.; May, G.; Miller, D. B. (Imperial Coll. of Science and Technology, London (UK)); Allen, J. E.; March, P. V.; Morris, S. H.; O'Brien, K. Nucl. Phys., B; 99: No. 2, 211-231(24 Nov 1975).

Results are given from a study of 15,518 events of the reaction $K^+d \rightarrow K^+\pi^-pp$. The $K^+\pi^-$ spin density matrix and the constraints imposed on it by positivity have been studied. Analyses of $K^+\pi^- \rightarrow K^+\pi^-$ elastic scattering have been carried out using methods developed by Estabrooks and Martin and Ochs and Wagner for the analogous case of $\pi\pi$ scattering. Results are found to be in agreement with earlier $K\pi$ scattering studies using the reaction $K^+p \rightarrow K^+\pi^-\Delta^{++}$ at much higher energies. The S-wave scattering length is found to be in agreement with the prediction of current algebra. (NL)

24432 DOUBLE POMERON EXCHANGE AND DIFFRACTIVE DISSOCIATION IN THE REACTION $pp \rightarrow pp\pi^+\pi^-$ AT 69 GeV/c. Denegri, D.; Derre, J.; Jabiol, M. A.; Otwinowski, S.; Pauli, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires); Ermolov, P. F.; Kistenev, E. P.; Moiseev, A. M.; Uchanov, M. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij); Bialkowska, H. Nucl. Phys., B; 98: No. 2, 189-203(3 Nov 1975).

The main features of the reaction $pp \rightarrow pp\pi^+\pi^-$ at 69 GeV/c are investigated from data obtained in the Mirabelle bubble chamber at Serpukhov. A search for a double pomeron exchange mechanism contribution leads to an upper limit of approximately equal to 20 μb for $M(\pi^+\pi^-) \leq 0.7$ GeV under reasonable assumptions. The four-body final state is dominated by proton diffractive dissociation $p \rightarrow p\pi^+\pi^-$(mostly $\Delta^{++}\pi^-$). The cross section for this process, as well as the t production slope and the decay distributions (of the Δ^{++}) show little variation in comparison with lower energy data. (NL)

24433 PARTIAL WAVES IN THE K^+p INTERACTION BETWEEN 1.2 AND 1.7 GeV/c. Lesquoy, E.; Muller, A.; Triantis, F. A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Berthon, A.; Montanet, L.; Paul, E.; Saetre, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 99: No. 2, 346-364(24 Nov 1975).

A simultaneous partial-wave analysis of the three final states K^+p,$K^*(892)N$ and $K\Delta(1236)$ is attempted using inelastic data with large statistics at 1.21, 1.29, 1.38 and 1.69 GeV/c as well as existing data on the elastic reaction. The constraint of unitarity, which is almost saturated by these reactions, allows one to determine the size and relative phases of the dominant partial waves and to give some limits on the others. Their variation with energy is discussed, as well as the consistency of the different sets of elastic phase shifts with the inelastic data. The predictions of the duality hypothesis are also compared with the data. (NL)

24434 NULL TECHNIQUE FOR CALIBRATING POLARIZATION VALUES IN πp SCATTERING. Daum, C.; Keaton, P. W. Jr. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 129: No. 1, 85-89(1 Nov 1975).

The purpose of the investigation was to find regions of energy and angle for πp elastic scattering in which the proton polarization P reaches its maximum value of unity. For incident pion beam energies below 900 MeV, five such regions exist in π^+p and six such regions exist in π^-p, as shown by simple graphic techniques. This suggests that crude polarized target experiments measuring the Wolfenstein parameters R and A will precisely determine the proton polarization because of the quadratic relation $P^2 + R^2 + A^2 = 1$. (NL)

24435 EXPERIMENTAL SURVEY OF ^{8}Li EMISSION IN 50 GeV/c π^- INTERACTIONS WITH EMULSION NUCLEI. Kumar, V.; Sharma, G. P.; Sharma, A. P. (Kurukshetra Univ. (India). Dept. of Physics). Phys. Lett., B; 59: No. 1, 95-98(13 Oct 1975).

From the NIKFI-R emulsions exposed to 50 GeV/c π^- beam, 82 events of hammer tracks (HTs) are collected. Energy spectra, total number of heavy prongs (N_h) versus average energy spectra and forward to backward ratio (F/B) in different cases are studied. The angular distribution of the events is found anisotropic. The process of jet formation affects the direction of emission of the intermediate mass nuclei. (NL)

24436 SOME ASPECTS OF LAMBDA PRODUCTION IN THE EXCLUSIVE REACTIONS $K^-p \rightarrow \Lambda^0 + n$ PIONS AT 8.25 GeV/c. Girtler, P.; Markytan, M.; Dallman, D. P.; Mitaroff, W. A. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Hochenergiephysik); Apostolakis, A.; Papelias, P.; Rozaki, H.; Stasinaki, M.; Vassiliadis Alcis, G. (Athens Univ. (Greece)); Filippas, T. A. Nucl. Phys., B; 99: No. 1, 13-29(17 Nov 1975).

Cross sections are given for the various exclusive reactions $K^-p \rightarrow \Lambda^0 + n$ pions, as well as for quasi two-body final states involving ρ^0, ω^0 and $Y^*(1385)$ resonance production. The general features of Λ^0 production are presented as a function of the pion multiplicity n. Production of $Y^{*+}(1385)$ is clearly observed at all multiplicities while the $Y^{*-}(1385)$ signals grow with the multiplicity, as expected in a non-exotic exchange picture. The polarization of the Λ^0 is consistent with zero everywhere, except when it is a decay product of $Y^*(1385)$, when non-zero values are found for odd values of n. The reactions $\Lambda^0 + 2\pi$ and $\Lambda^0 + 3\pi$ are analyzed in terms of the Plahte-Roberts model and good overall agreement is obtained for the various effective mass distributions and the p_L, p_T and cos θ distributions for the individual particles. (NL)

24437 MEASUREMENT OF THE DIFFERENTIAL CROSS SECTION AND THE SPIN-CORRELATION PARAMETERS P, A, AND R IN THE BACKWARD PEAK OF $\pi^-p \rightarrow K^0\Lambda$ AT 5 GeV/c. Astbury, P.; Gallivan, J.; Jafar, J.; Letheren, M.; Steiner, V.; Wilson, J. A. (Imperial Coll. of Science and Technology, London (UK)); Beusch, W.; Borghini, M.; Websdale, D. (European Organization for Nuclear Research, Geneva (Switzerland)); Fluri, L. Nucl. Phys., B; 99: No. 1, 30-52(17 Nov 1975).

Measurements are presented for the baryon-exchange reaction $\pi^-p \rightarrow AK^0$ at 5 GeV/c over the range $-u < 2$ (GeV/c)^2. The differential cross section is obtained from events produced on a liquid hydrogen target. These data are combined with events produced on a butanol polarized target and the parameters P, A and R are then determined from an analysis of the decay angular distribution of the forward-going Λ. From the data it is possible to determine the magnitudes and the relative phase of the two invariant amplitudes A' and B. The consequences for the ratio B/A' are discussed in detail. (NL)

24438 MEASUREMENT OF THE POLARIZATION IN THE FORWARD PEAK OF $\pi^-p \rightarrow K^0\Lambda$ AT 5 GeV/c. Beusch, W.; Borghini, M.; Lauper, S.; Websdale, D. (European Organization for Nuclear Research, Geneva (Switzerland)); Fluri, L.; Gentit, F. X. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)); Astbury, P.; Gallivan, J.; Jafar, J.; Letheren, M. Nucl. Phys., B; 99: No. 1, 53-60(17 Nov 1975).

The $\pi^-p \rightarrow K^0\Lambda$ polarization has been measured at 5 GeV/c in the range $0 < -t < 1.4$ (GeV/c)^2. The polarization is small for $-t < 0.4$ (GeV/c)^2, becoming negative at the higher values of $-t$. (NL)

24439 DIFFERENTIAL CROSS SECTION FOR $\pi^- p \to \eta^0 n$ AT 6.0 GeV/c. Shaevitz, M.H.; Reay, N.W.; Reibel, K.; Stanton, N.R. (Physics Department, The Ohio State University, Columbus, Ohio 43210); Edwards, K.W.; Luxton, G.; Abolins, M.A.; Sidwell, R.A.; Dankowych, J.A.; Luste, G.J.; Martin, J.F.; Prentice, J.D. Phys. Rev. Lett. 36: No. 1, 5-8 (5 Jan 1976).

We have measured the differential cross section for $\pi^- p \to \eta^0 n$ at 6.0 GeV/c from 6730 very clean events in which the decay $\eta \to \pi^+ \pi^- \pi^0$ was detected. The high statistics reveals a sizable forward turnover, implying a dominance of the helicity-flip amplitude. A precisely determined A_2 trajectory, linear for $|t| < 1.0(\mathrm{GeV}/c)^2$, is found from combining our data with those at energies up to 101 GeV. (auth)

24440 HIGH-STATISTICS STUDY OF ω^0 PRODUCTION. Shaevitz, M.H.; Reay, N.W.; Reibel, K.; Stanton, N.R. (Physics Department, The Ohio State University, Columbus, Ohio 43210); Edwards, K.W.; Luxton, G.; Abolins, M.A.; Sidwell, R.A.; Dankowych, J.A.; Luste, G.J.; Martin, J.F.; Prentice, J.D. Phys. Rev. Lett. 36: No. 1, 8-11 (5 Jan 1976).

We report results from a study of $\pi^- p \to \omega^0 n$ at 6.0 GeV/c based on 28 000 events from a charged and neutral spectrometer. Background under the ω^0 is only 7%, a large improvement over deuterium–bubble-chamber work. Density matrix elements, projected cross sections, and effective trajectories for natural and unnatural exchanges are presented. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 24410.

24441 (CONF-741181-P1) PROCEEDINGS OF THE II HIGH ENERGY PHYSICS SYMPOSIUM, VISVA-BHARATI, SANTINIKETAN, INDIA, NOVEMBER 9–13, 1974. Malhotra, P. K.; Ganguli, S. N.; Sarma, K. V. L. (eds.). (Department of Atomic Energy, Bombay (India)). 1974. 232p.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

Separate abstracts were prepared for the ten papers presented. (JFP)

For abstracts of individual papers see: 24414, 24442–24444, 24518, 24519, 24536, 24537, 24563, and 25026.

24442 (CONF-741181-P1, pp 1-21) RECENT TRENDS AND PERSPECTIVES IN HIGH ENERGY PHYSICS. Biswas, S. N. 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

The discussion of recent trends and perspectives in high energy physics covers quarks, strings, and gauge fields. (JFP)

24443 (CONF-741181-P1, pp 22-62) HIGHLIGHTS FROM XVII INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS. Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

The review of the conference on high energy physics covers total cross sections, diffraction dissociation, correlations and cluster formation, large transverse momentum phenomena, multiparticle production in hadron–nucleus collisions and a brief coverage of e^+e^- annihilation, neutral currents, and charm particles. (JFP)

24444 (CONF-741181-P1, pp 188-202) FUNDAMENTAL LENGTH. Pradhan, T. (Inst. of Physics, Bhudaneswar, India). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

The treatment of the fundamental length includes the fundamental length in quantum electrodynamics, the quantization of length, and the fundamental length in nonpolynomial theory. (JFP)

24445 (CONF-741181-P2(Absts.)) II HIGH ENERGY PHYSICS SYMPOSIUM, VISVA-BHARATI, SANTINIKETAN, NOVEMBER 9–13, 1974. (Department of Atomic Energy, Bombay (India)) 1974. 86p.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

A collection of abstracts of papers for a high energy physics symposium are presented. (JFP)

24446 (ORO-3992-250) DROPLET QUARK MODEL OF HADRONS. Werle, J. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. 18p. (CONF-760118-5). Dep. NTIS $3.50.

From symposium on mathematical physics; Mexico City, Mexico (5 Jan 1976).

A relativistic classical hydrodynamical model is proposed in which the quarks are regarded as suitably charged fluids. Also proposed is a quark model of hadrons based on a local and highly symmetric but nonlinear interaction function of a current–current invariant. (JFP)

24447 (RL–75-164) REGGE PHENOMENOLOGY OF INELASTIC DIFFRACTION. Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Oct 1975. 28p. Dep. NTIS (US Sales Only) $4.00.

The present status of data on inelastic diffraction is reviewed in terms of triple-Regge analysis. While the quality of the data is good, discrepancies between different experiments cannot allow an estimation of the triple-Pomeron coupling at t = o to better than about 50%. The various components of σ_{DIFF} are discussed, in particular the double Pomeron exchange (DPE) contribution. Estimates are given for DPE inclusive and exclusive reactions and also what else can be learned from measuring $pp \to pX$. Finally the present status of f-dominated Pomeron models in diffractive scattering is discussed. (auth)

24448 INTERACTION OF GOLDSTONE PARTICLES IN TWO DIMENSIONS. Applications to Ferromagnets and Massive Yang–Mills Fields. Polyakov, A. M. (AN SSSR, Moscow. Inst. Teoreticheskoj Fiziki). Phys. Lett., B; 59: No. 1, 79-81(13 Oct 1975).

Interaction of Goldstone particles in two dimensions leads to the infrared catastrophe. In order to analyze it the method of the renormalization group is applied to the problem. It is shown that due to interaction the regime of the "asymptotic freedom" arises. The continuation to higher dimensions and the applications of the result are briefly discussed. (NL)

24449 ONE-DIMENSIONAL APPROXIMATION FOR THE POMERON IN THE DUAL UNITARITY SCHEME. Sakai, N. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys., B; 99: No. 1, 167-188(17 Nov 1975).

Using a one-dimensional approximation, the pomeron in the dual unitarity scheme is examined analytically in a multiperipheral cluster model. Clusters have negative short range correlations due to the $t_{\min}$ effect. In dual models, the pomeron has a crossing odd part, especially in $B\bar{B}$ and BB scattering. By taking all reggeon loops into account, it is shown explicitly in the approximation that the crossing-odd part has only lower-lying singularities in the j-plane (typically complex poles with Re $\alpha \simeq 0.2$) whereas the crossing-even part has the leading singularity at $j = \alpha_p$ ($\alpha_p = 1$ imposed). The dual unitarity scheme leads to a modified version of the f-dominance of the pomeron. The SU(3) breaking of the pomeron due to the SU(3) breaking among Regge trajectories is calculated without additional assumptions on the SU(3) property of the pomeron. (NL)

24450 INCLUSIVE STUDY OF HIGH-ENERGY MULTIPARTICLE PRODUCTION AND TWO-BODY CORRELATIONS. Foa, L. (Scuola Normale Superiore, Pisa (Italy)). Phys. Rep.; 22: No. 1, 1-56(Nov 1975).

The present experimental information on multibody hadron production is examined in the framework of an inclusive and semi-inclusive approach. In the first part, the trends towards possible asymptotic limits is briefly discussed. The main part of this review is then devoted to the study of inclusive and semi-inclusive two-particle correlations. (NL)

24451 FUNCTIONAL INTEGRATION APPROACH TO THE THEORY OF THE ONE-DIMENSIONAL BAG. Rebbi, C. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Phys., B; 99: No. 2, 287-316(24 Nov 1975).

A functional integration in the euclidean domain is used to define and to evaluate the Green functions in the theory of the one-dimensional relativistic bag. It is shown that the Green functions so defined have factorized poles corresponding to the quantum states of excitation of the system. An analysis is presented of the main properties of the on-mass-shell amplitudes, of the two current vacuum correlation function and of the form factors. (NL)

24452 EXPONENTIAL HADRONIC SPECTRUM AND QUARK LIBERATION. Cabibbo, N. (Rome Univ. (Italy). Istituto di Fisica); Parisi, G. (Istituto Nazionale di Fisica Nucleare, Frascati, Italy). Phys. Lett., B; 59: No. 1, 67-69(13 Oct 1975).

The exponentially increasing spectrum proposed by Hagedorn is not necessarily connected with a limiting temperature, but it is present in any system which undergoes a second order phase transition. It is suggested that the "observed" exponential spectrum is connected to the existence of a different phase of the vacuum in which quarks are not confined. (NL)

24453 NUCLEAR ELECTROPRODUCTION OF NEGATIVE PIONS BELOW THRESHOLD. Koch, J. H. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Phys. Lett., B; 59: No. 1, 45-48(13 Oct 1975).

The electroproduction of negative pions into bound atomic states is calculated. The effect of the strong π-nucleus interaction is included in the calculation. (NL)

24454 PROPERTIES OF HADRONS AS QUARK BOUND-STATES ON THE NULL PLANE. Abud, M.; Lacaze, R.; Savoy, C. A. (Geneva Univ. (Switzerland)). Nucl. Phys., B; 98: No. 2, 215-236(3 Nov 1975).

Specific properties of the interacting quark fields when quantized on the null plane are exploited in order to construct one-hadron states. The Melosh transformation naturally appears in the definition of these relativistic quark bound states and it implies a definite pattern for SU(6) and SU(3) breaking in the various coupling constants. The only three parameters of the model, $\langle p_\perp^2 \rangle$ and the two quark effective masses, are determined from the experimental values of g_A, μ_{proton} and μ_Λ. Many results are then obtained and successfully compared with experiments. (NL)

24455 FURTHER APPLICATIONS OF SU_{6W} DECAY SCHEMES FOR BARYONS. Cashmore, R. J. (Oxford Univ. (UK). Dept. of Nuclear Physics); Hey, A. J. G. (Southampton Univ. (UK). Dept. of Physics); Litchfield, P. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys.; 98B: No. 2, 237-258(3 Nov 1975).

A previous SU_{6W} analysis of baryon decays is extended to include further possible $SU_{6W}XO_3$ multiplets, and in particular the Roper multiplet. Both pion and photoproduction data indicate that the two available nucleon P11 resonances cannot be classified in even parity 70 multiplets. Both are consistent with $(56,0^+)$ radial excitation assignments, thus casting some doubt on explicit energy level calculations of conventional harmonic oscillator quark models. For the $(70,1^-)$ and $(56,2^+)$ multiplets, the rhoN decays are compared with the predictions of an SU_{6W} model motivated via the Melosh transformation. There are possible difficulties but no striking sign disagreements. It is concluded that there is strong evidence for an algebraic SU_6 structure in the baryon decays but that other more specific SU_6 models seem to be in difficulty. (NL)

24456 COMMENTS ON THE LOW-ENERGY $\pi\pi$ P-WAVE. Basdevant, J. L.; Chapelle, P.; Lopez, C.; Sigelle, M. (Paris-6 Univ., 75 (France). Lab. de Physique Theorique et Hautes Energies). Nucl. Phys.; 98B: No. 2, 285-297(3 Nov 1975).

The disagreement between the $\pi\pi$ P-wave as measured in the CERN-Munich experiment and as determined phenomenologically is analyzed. There is no way in which the dispersion relation results can agree with the data, unless some currently accepted properties, which are displayed, are discarded. In the course of this work some important dynamical observations are made. (NL)

24457 COLORED MAGNETIC MONOPOLES. Eguchi, T. (Chicago Univ., Ill, (USA). Enrico Fermi Inst.). Phys. Lett., B; 59: No. 1, 73-78(13 Oct 1975).

Dirac's theory of magnetic monopoles is extended to the case of non-Abelian color gauge groups. The exact classical solution is obtained by making use of the gauge-independent method of a Yang-Mills field. The case of broken gauge symmetry is also briefly discussed. (NL)

24458 SINGLE AND DOUBLE DIFFRACTION DISSOCIATION AT FNAL AND ISR ENERGIES. Goggi, G. (Pavia Univ., Italy). pp 19-46 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

The present status of single and double diffraction dissociation at high energies is discussed in view of recent results and new preliminary data from FNAL and ISR on both types of processes. Some results of the Pavia-Princeton collaboration on exclusive double diffraction dissociation at the ISR are presented. (auth)

24459 MULTIPARTICLE PRODUCTION IN PARTICLE-NUCLEUS COLLISIONS AT HIGH ENERGIES. Berlad, G.; Dar, A.; Eilam, G. (Inst. of Tech., Haifa, Israel). pp 245-255 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A simple model is proposed for multiparticle production in high energy particle-nucleus collisions. The production process factorizes into a product of nuclear properties and measured particle-particle collision properties. Most results are insensitive to nuclear structure details. Good agreement between experiment and theory is obtained. An important implication to high energy particle physics research is pointed out. (auth)

24460 DUAL ANALYTIC MODEL FOR THE POMERON. II. Kobylinskii, N. A.; Martynov, E. S. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1633-1639(Oct 1975). (In Russian)

A study is continued of the problem concerning inclusion of the pomeron singularity into vacuum channels of the dual analytic model for N-point amplitude. The cross section of diffractive dissociation of an incoming particle is evaluated from the six-point model amplitude with simple and double P-poles in three channels. It is shown that the vertex function in diagrams with a triple-pomeron vertex has no zero at zero transferred momenta when one or several double poles are present in 3P-vertex. This leads to diffractive cross-section rise, the rise value being determined by the number of double poles coupled in the vertex. (auth)

24461 HOW TO EVALUATE CROSS SECTIONS IN MODELS WHERE THE S-MATRIX IS UNITARY BUT DOES NOT CONSERVE ENERGY. Jurkiewicz, J. (Jagellonian Univ., Krakow); Zalewski, K. Acta Phys. Pol., Ser.; B7: No. 1, 39-41(Jan 1976).

The standard time-dependent description of the scattering processes is used to explain that, when the S-matrix does not conserve energy, the coefficient relating the squared modulus of the S-matrix element to the cross section becomes model-dependent, and the optical theorem does not necessarily follow from the unitarity of the S-matrix. It is suggested that, if one insists on using such models, the optical theorem should be imposed as a constraint and used to fix the model-dependent coefficient. (auth)

24462 INFORMATION CONTENT ON PRODUCTION MODELS. Camisassa, G.; Fre, P.; Sertorio, L. (Univ., Turin). Nuovo Cim.; 30B: No. 2, 364-389(11 Dec 1975).

The information content of the statement that the transverse momenta in production scattering are strongly cut is quantitatively defined. This measure of information is compared with the statistical mechanical entropy both in the old limit of a pion gas at high temperature and in the new Hagedorn limit with bounded temperature. A criterion for classifying statistical countings is given. (auth)

24463 NEGATIVE-REST MASS PROPOSAL FOR ANTIMATTER. Edmonds, J. D. Jr. (Claremont Colleges, CA). Lett. Nuovo Cim.; 15: No. 1, 15-16(3 Jan 1976).

The possibility is explored that no particle is identicle with its antiparticle. Negative mass for antimatter is not a new idea, but it is treated by considering rest mass as an eigenvalue of 4th space dimension derivative. (JFP)

24464 GALILEAN INVARIANCE, GAUGE INVARIANCE, AND SPIN-DEPENDENT HAMILTONIANS. Celeghini, E.; Lusanna, L.; Sorace, E. (Univ., Florence). Nuovo Cim.; 31A: No. 1, 89-99 (1 Jan 1976).

Extending Jauch's procedure to particles with spin, one obtains the most general spin-dependent Hamiltonian; gauge invariance and dimensional arguments reduce it to the usual Pauli one, allowing thus a generalization of the minimal coupling rule, in the case of Galilean electromagnetic interactions. One also shows giving a counter-example, that gauge invariance is not implied by Galilean invariance. (auth)

24465 CORRECTIONS TO KNO SCALING. Ernst, W.; Schmitt, I. (Univ., Bielefeld, Ger.). Nuovo Cim.; 31A: No. 1, 120-128(1 Jan 1976).

Corrections to KNO scaling are calculated by using a method discussed previously. Substantial deviations from the asymptotic KNO curve are found which are not in contradiction with the data. (auth)

24466 KNO SCALING AND RENORMALIZATION GROUP. Ernst, W.; Schmitt, I. (Univ., Bielefeld, Ger.). Nuovo Cim.; 31A: No. 1, 109-119(1 Jan 1976).

KNO scaling is derived using a differential equation which results from combining the renormalization group with experimentally observed regularities of the dispersion of the multi-

plicity distribution in high energy collisions. The KNO scaling function $\psi(N/\langle N\rangle)$ is compared with the experimental data. (auth)

24467 GENERAL THEORY OF MULTIPARTICLE PRODUCTION IN THE EIKONAL FORMALISM. Doi, M. (Osaka Coll. of Pharmacy). Nuovo Cim.; 31A: No. 1, 163-181(1 Jan 1976).

The multiparticle process is investigated in the framework of the covariant field theory and the eikonal formalism. Mechanisms assumed for the scattering and the particle production have sufficient generality. The eikonal approximation about incident energetic particles leads to an impact-parameter picture, and closed forms for the amplitudes are obtained. From the study of the unitarity, the interrelation between the elastic and production channels is revealed, and it is explicitly shown how the absorptive part of the eikonal phase shift is settled as a reflection of the multiparticle production. Expressions for some of physical observables are also derived. (auth)

24468 QUANTIZED EXCITATIONS OF RELATIVISTIC EXTENDED ELEMENTARY PARTICLES. Barut, A. O. (Univ. of Colorado, Boulder); Raczka, R. Nuovo Cim.; 31B: No. 1, 19-31 (11 Jan 1976).

The nonlinear field theory of three-dimensional extended classical objects is considered. The elementary excitations of these fields and the corresponding reduced Hamiltonian and reduced wave equations are derived. One proposes to quantize the periodic elementary excitations and not the fields. The canonical quantization of these reduced motions is performed and the resulting mass spectra and trajectories of quantized elementary excitations are derived. Although the theory is relativistic, the degrees of freedom in the reduced wave equation satisfy Schroedinger-like "nonrelativistic" equations. (auth)

24469 THEOREM ON CLUSTER FORMATION IN HIGH ENERGY MULTIPARTICLE PROCESSES. Ballestrero, A. (Univ., Turin); Predazzi, E.; Page, R. Lett. Nuovo Cim.; 15: No. 2, 57-59(10 Jan 1976).

It is shown that within a previous scheme, cluster emission is a must provided only that the physical total elastic cross sections have the same asymptotic behavior and that the mean multiplicity of pions produced is an increasing function of energy. Also one can prove with increasing energy the mean number of cluster tends to a constant which can be roughly estimated. As a consequence, the mass of at least some cluster must increase. (JFP)

24470 PARITY VIOLATING COMPTON AMPLITUDE IN UNIFIED THEORIES. Baće, M.; Hari Dass, N.D. (Max-Planck-Institut für Physik und Astrophysik München, West Germany). Ann. Phys. (N.Y.) 94: No. 2, 349-373 (Oct 1975).

The leading contribution of $O(\alpha G_F)$ to the parity violating piece of the electron Compton amplitude is calculated in the Weinberg Salam unified theory and is shown to vanish. The reason for this is the nonexistence of parity violating charge and electric dipole moment. In the computation, a problem with the usual gauge fixing terms in the Weinberg model was encountered and resolved; the gauge fixing terms made it impossible to satisfy the electromagnetic Ward identity off mass-shell. The resolution of this problem has led to changed Feynman rules resulting in fewer graphs and gauge dependent vertices. Further features are a renormalization of the parity violating infinities, and a discussion of how the γ_5-algebra and n-dimensional regularization can coexist peacefully. (auth)

24471 DYNAMICAL CALCULATION OF THE A_1. Brayshaw, D.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 36: No. 2, 73-76 (12 Jan 1976).

A relativistic three-body theory previously used to generate the ω has been applied to the 1^+ state of three pions. An A_1 resonance pole is produced with $M_{A_1} = 1160$ MeV, $\Gamma/2 = 90$ MeV, but there is no associated phase variation of the amplitude. (auth)

24472 REMARKS ON MODELS FOR THE J AND OTHER ψ PARTICLES. Pakvasa, S.; Pilachowski, L.; Simmons, W.A.; Tuan, S.F. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). Phys. Rev. D 13: No. 1, 156-160 (1 Jan 1976).

We make some comments concerning charm-related models, the Schwinger phenomenological theory, and a possible multiplicative t quantum-number scheme for the J and other ψ particles. It is seen that an accurate measurement of the rate $J^0 \to \pi^+ + \pi^- + \gamma$, a search for *narrow-width* $(I^G, J^P) = (1^+, 1^+)$ particles (with the vector particle probably below 3.1 GeV), and a possible enhanced pair production of (JJ) and $(J\psi)$ in hadron-initiated reactions at high energies remain of substantial interest in sorting out our options. (auth)

24473 ONE-BOSON-EXCHANGE N^* (1236) -N POTENTIAL. Dillig, M. (Institute for Theoretical Physics, University of Erlangen-Nuernberg, Erlangen, Germany). Phys. Rev. D 13: No. 1, 179-183 (1 Jan 1976).

A one-boson-exchange potential between an N^* (1236) and a nucleon is derived. Quantitative predictions are influenced by significant uncertainties in the coupling constants, vertex corrections, and modifications due to the finite lifetime of the N^*. (auth)

24474 NEW QUANTUM NUMBER IN THE NIEH-WU-YANG THEORY. Lo, S.Y. (School of Physics, University of Melbourne, Parkville, Victoria, 3052, Australia). Phys. Rev. D 13: No. 1, 184-187 (1 Jan 1976).

The possibility of extending the new quantum number introduced by Niech, Wu, and Yang to account for new experimental observation is discussed. A t-spin scheme as contrasted to an additive scheme is discussed. (auth)

24475 MESON DECAY RATES. O'Donnell, P.J. (Department of Physics and Scarborough College, University of Toronto, Toronto, Ontario, M5S 1A7 Canada). Phys. Rev. Lett. 36: No. 4, 177-179 (26 Jan 1976).

The new decay rates of mesons which have been published within the last year are examined to determine their consistency with SU(3) symmetry, vector dominance, and the quark model. It is shown that despite an apparent overall trend of the new data to disagree with certain quark-model predictions by a factor of 3 or so, the consistency of the data with usual ideas of low-energy phenomenology is impressive. It would appear that the new data do not constitute a crisis for the "old" physics. (auth)

24476 POSSIBLE EVIDENCE FOR THE QUANTIZATION OF PARTICLE LIFETIMES. Ehrlich, R. (Department of Physics, State University College, New Paltz, New York 12561). Phys. Rev. D 13: No. 1, 50-55 (1 Jan 1976).

An analysis of widths of resonant states supports the hypothesis that particle lifetimes are quantized in units of 1/2 or possibly 1/4 the lifetime of the ρ meson: $(4.40 \pm 0.06) \times 10^{-24}$ seconds. The probability that the observed regularity in resonance widths (lifetimes) is simply due to chance is estimated to be less than 2×10^{-4}. Possible ramifications of this result are considered. (auth)

24477 COMMENTS ON "NEW EXTENDED MODEL OF HADRONS". Basu, D. (Physics Department, Indian Institute of Technology, Kharagpur, West Bengal, India); Ghose, P. Phys. Rev. D 12: No. 12, 4006-4007 (15 Dec 1975).

It is shown that a variety of boundary conditions for fermions as well as bosons in a bag model can be derived in a unified manner from a single variational principle. A new condition for scalar bosons has been obtained as an example. (auth)

24478 POMERON-REGGEON RELATIONSHIP ACCORDING TO THE TOPOLOGICAL EXPANSION. Chew, G.F.; Rosenzweig, C. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 12: No. 12, 3907-3920 (15 Dec 1975).

The nature of the Pomeron and related effects are studied within the framework of Veneziano's topological expansion. At the second, or cylinder, level it is found that no new poles are generated but that first-level (planar) poles with $I = 0$ are shifted by the cylinder, the shifts being in opposite directions for positive and negative charge conjugation. The planar f, in particular, is shifted upward and may be interpreted near $t = 0$ as the Pomeron—with couplings lying roughly midway between the ideal mixing of a planar f and an SU_3 singlet. The Pomeron intercept and couplings (mixing coefficients) together with corresponding intercepts and couplings for ω, f', and ϕ are semiquantitatively related through a single parameter to the properties of ρ-A_2. In the positive-t physical-particle region corresponding relations successfully correlate the breaking of the Iizuka-Okubo-Zweig rule to the ρ-ω mass difference. Comparison of the cylinder shift in this large-t region to that near $t = 0$ reveals the phenomenon of "asymptotic planarity"—the cylinder perturbation dying out rapidly with increasing t. It is pointed out that the small Pomeron slope as well as certain physical effects attributed in field theory to asymptotic freedom are consequences of asymptotic planarity. (auth)

24479 RELATIVISTIC BOUND-STATE MODELS WITH QUASIFREE CONSTITUENT MOTION. Blaha, S. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. D 12: No. 12, 3921-3937 (15 Dec 1975).

Prototype relativistic bound-state models are considered which avoid normalization and spectral problems usually associated with such models. A novel approach based on the use of hyperboloidal coordinates allows us to take advantage of an attractive angular-momentum-like term in $\Box$ to obtain kinematic binding in the timelike region of the relative-coordinate Minkowski space. Besides allowing for a type of free quark behavior within the bound state this feature eliminates the spectral problem. We develop a half-space harmonic-oscillator model with a positive-definite, almost linear spectrum. (auth)

24480 KINEMATICAL CONSTRAINTS ON THE OBSERVATION OF SLOW MONOPOLES AT THE TOP OF THE

ATMOSPHERE. Badhwar, G.D.; Golden, R.L.; Lacy, J.L.; Stephens, S.A.; Cleghorn, T. (National Aeronautics and Space Administration, Johnson Space Center, Houston, Texas 77058). Phys. Rev. Lett. 36: No. 3, 120-123 (19 Jan 1976).

Relativistic kinematics of monopole production and propagation in Earth's atmosphere and magnetic field have been examined in the light of the observation of a magnetic monopole by Price *et al.* It has been shown that the observed monopole cannot result from nuclear interactions in the atmosphere and that the extraterrestrial origin of this monopole is very unlikely. (auth)

24481 DIAGONAL VERSUS NONDIAGONAL COUPLINGS OF ψ PARTICLES. Clavelli, L.; Nussinov, S. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 13: No. 1, 125-128 (1 Jan 1976).

In essentially all common models of the ψ particles off-diagonal couplings such as $\psi\psi\pi\pi$ are expected to be greatly suppressed relative to diagonal couplings such as $\psi\psi\pi\pi$. We point out that this is counter-indicated by the data, leading to important constraints on model building. (auth)

24482 STUDY OF MULTIPARTICLE PRODUCTION IN REGGEON FIELD THEORY. Bartels, J.; Rabinovici, E. Phys. Rev. D 12: No. 12, 3938-3962 (15 Dec 1975).

The concept of Reggeon field theory (RFT) is applied to particle production in the multi-Regge region. For processes with repeated Pomeron ($\tilde{P}$) exchange we calculate the high-energy behavior of the production cross sections $\sigma_n(s)$ and find that $\sigma_n(s) \sim \sigma_{el}(s) \sim (\ln s)^{-5/6}$ for every n. It is then shown that s-channel unitarity constraints are respected: in the absence of $\tilde{P}$ cuts these processes are known to violate the Froissart bound (Finkelstein-Kajantie problem). We show that the inclusion of $\tilde{P}$ cuts in our RFT model solves this problem, provided the $\tilde{P}$-particle-$\tilde{P}$ vertex is not large. Furthermore, we demonstrate that the way in which s-channel unitarity is restored does not lead to decoupling problems. Finally, particle production with a secondary Reggeon exchange is considered. We find that the $\sigma_n(s)$ have qualitatively the same behavior as in the absence of $\tilde{P}$ cuts. (auth)

24483 HYPERFINE SPLITTING OF GROUND-STATE CHARMONIUM. Schnitzer, H.J. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 13: No. 1, 74-81 (1 Jan 1976).

The mass splitting of ψ (3100) and its pseudoscalar partner η_c is examined within the context of nonrelativistic linear-potential models for bound charmed quarks. If the Coulomb-type short-range gluon interaction is the sole contribution to this hyperfine splitting, then a mass splitting of 15–25 MeV is obtained. However, if the long-range forces that confine quarks also produce shorter-range spin-spin interactions, then the ψ-η_c mass splitting is predicted to be in the range 40–80 MeV. If one abandons the assignment of ψ' (3700) as the first radial excitation of ψ (3100), then the η_c is predicted to lie 150–300 MeV below ψ (3100). This possibility has the consequence that the rate predicted for the yet-unobserved decay $\psi \to \eta_c + \gamma$ is uncomfortably large. (auth)

24484 AN ANALYSIS OF A NEW QUARK MODEL OF HADRONS. Harari, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Ann. Phys. (N.Y.) 94: No. 2, 391-416 (Oct 1975).

We present a detailed analysis of our new quark model, which proposes an antitriplet of new heavy quarks in addition to the familiar u,d, and s quarks. The suggestion of three new quarks is motivated by the existence of three ψ-particles and by the observed value of $R=\sigma(e+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$. We show that ours is the only model with three new quarks that is consistent with $R \sim 5$ and with the relative leptonic widths of the ψ-particles. The structure of the weak currents in the model prevents $|\Delta S|=1$ neutral currents in a natural way. A spectrum of heavy mesons and baryons is predicted and their decay modes, production, and experimental search are discussed. Radiative decays of ψ' (3700) into positive parity ψ-like states, which are predicted by the Charm scheme and are not found, are not predicted in our model. However, the hitherto unobserved pseudoscalar ψ-like particles predicted by all $q\bar{q}$ schemes are also predicted by us. (auth)

24485 DYNAMICAL BREAKING OF GENERAL COVARIANCE AND MASSIVE SPIN-2 MESONS. Duff, M.J. (Department of Mathematics, King's College, London WC2R 2LS, England). Phys. Rev. D 12: No. 12, 3969-3971 (15 Dec 1975).

In a system of massive fermions in interaction with massless tensor and scalar mesons, the existence of a massless vector bound state in the fermion-antifermion channel gives a mass to the spin-2 particle and leads to a gauge-invariant and unitary S matrix which is completely free of massless poles. (auth)

24486 PHASE TRANSITIONS OF SECOND AND ZERO KIND IN HIGH-ENERGY PHYSICS: A PHENOMENOLOGICAL FIELD-THEORETICAL APPROACH. σ MODEL AND SUPERFLUIDITY OF HADRONIC MATTER. Eliezer, S. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545); Weiner, R.M. Phys. Rev. D 13: No. 1, 87-94 (1 Jan 1976).

We introduce the temperature concept of Fermi, Landau, and Hagedorn associated with the energy of an elementary-particle reaction into the thermodynamics of field theory constructed by Weinberg for external temperature. For weak and electromagnetic interactions this implies that the phase transitions predicted within a unified gauge theory of electromagnetic and weak interactions should be looked for in elementary-particle interactions at very high energies (cosmic rays). The experimental observation of these effects which might include, e.g., conservation of strangeness in weak interactions will constitute one of the most clear-cut confirmations of the unified gauge theory. We formulate a phenomenological field theory at finite temperature and derive all the relevant thermodynamical quantities (thermodynamical potential, pressure, entropy, energy, specific heat, and velocity of sound). We consider two possible types of phase transitions, namely of second order and of zero order (Hagedorn type). We discuss the implications of phase transitions in strong interactions for the momentum distribution of secondaries. In the particular case of the σ model we find a phase transition of the second kind induced by the energy of the reaction and a phonon-like excitation spectrum for the pion cloud inside the nucleon in the spontaneously-broken-symmetry phase, giving support to the idea that hadronic matter has superfluid properties. This leads to scaling effects at low excitation energies in scattering reactions on nucleons. The broken symmetry is restored at a critical temperature T_c in agreement with previous phenomenological predictions based on a superfluid approach to strong interactions . Above T_c the parton masses vanish, which leads again to scaling, but this time in the high-energy-transfer domain. Conservation of axial-vector currents is found to hold in both phases. In the $T > T_c$ phase we expect chiral multiplets. (auth)

24487 FORM FACTORS OF VECTOR PARTICLES. Volkovitskii, P.Z.; Kaminskaya, E.P. (Institute of Theoretical and Experimental Physics). JETP Lett. 22: No. 4, 117-118 (20 Aug 1975).

We consider vector and axial form factors of the transition of a vector particle into a vector particle. It is shown that in the case when the masses of the vector particles are not equal there is an additional transition axial current. (auth)

Electromagnetic

24488 (CONF-7409140-P1, pp 297-324) PRICE OF GAUGE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Maiani, L. (Istituto Superiore di Sanita, Rome). 1974.

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In weak interactions. Vol. I.

A detailed discussion is given of intermediate bosons in a well defined range of masses, neutral currents and/or heavy leptons, and charmed particles. (JFP)

24489 (CONF-7409140-P2) PHOTO–HADRONS INTERACTIONS. Summer School on Particle physics, Gif-sur-Yvette, France, 9–21 September 1974. Volume II. Altarelli, G.; Diu, B.; Renard, F. M.; Soeding, P.; Tran Thanh Van, J. (Institut National de Physique Nucleaire et de Physique des Particules, 75–Paris (France)). 1974. 245p. (In French and English)

The conference included five papers. Four of these papers appeared previously in NSA. For abstracts of these papers see conference number 7409140-P2. An abstract was prepared for the remaining paper. (JFP)

For an abstract of an individual paper see: 24490.

24490 (CONF-7409140-P2, pp 3-63) PHOTON AND PHOTON REACTIONS: AN ELEMENTARY THEORETICAL INTRODUCTION. Diu, B. (Univ., Paris). 1974. (In French)

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In photon–hadrons interactions. Vol. II.

The principal properties of the photon are reviewed starting with those of the electromagnetic field and indicating to what they correspond from the quantum point of view. Also the behavior of the photon is specified with respect to internal symmetries (isospin and SU(3)). It is seen how electroproduction and electron–positron annihilation can be considered as reactions initiated by virtual photons. The introduced ideas are used to indicate reactions with photon interference (helicity and invariant amplitudes) using the example of pion photoproduction on a nucleon. (JFP)

24491 (CRN/HE–75-13) NEUTRAL CURRENTS AND HIGH-ENERGY LEPTON–NUCLEON ELASTIC SCATTERING. Fleury, N.; Leite Lopes, J. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). [nd]. 8p. Dep. NTIS (US Sales Only) $3.50.

The Salam–Weinberg model of unified weak and electromagnetic interactions predicts the existence of heavy neutral vector mesons z^0 responsible for neutral current couplings. These couplings have been found experimentally in the muonless events which occur in high-energy neutrino-nucleon scattering. Due to the large mass of the z^0-meson, it is expected that the contribution of the interaction which results from the virtual exchange of these quanta in charged lepton-nucleon elastic collisions is very small as compared to that of the electromagnetic interaction, for the high energies experimentally available. The cross section for lepton-nucleon elastic scattering has been computed with the aim of exhibiting these terms. (auth)

24492 (DESY–75/39) TARGET ASYMMETRY IN INCLUSIVE PHOTOPRODUCTION OF PIONS. Ahmed, K.; Koerner, J. G.; Kramer, G.; Craigie, N. S. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Oct 1975. 19p. Dep. NTIS (US Sales Only) $3.50.

The target asymmetry in inclusive pion photoproduction is studied in the photon fragmentation region using a helicity dependent Mueller-Regge model, in which the Regge cut contributions are also included. Predictions are obtained for the t–dependence and the magnitude of the target asymmetry. 4 figures. (auth)

24493 (DESY-75/43) MODEL FOR THE PROCESS $e^+e^- \to \rho^0\epsilon$. Gutbrod, F.; Weiss, U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1975. 25p. Dep. NTIS (US Sales Only) $3.50.

The $\rho\epsilon\gamma$ form factors were calculated in the timelike region from simple loop diagrams. The results for the cross section $e^+e^- \to 2\pi^+2\pi^-$ depend crucially on the model for the pion form factor. If $\rho\epsilon$–intermediate states are neglected there, the calculated cross sections fall much below the data. If these states are included and the existence of a ρ'-meson is assumed, the data are explained correctly. (auth)

24494 (DESY–74/48) ELECTROMAGNETIC N–N* TRANSITION FORM FACTORS. Devenish, R.C.E.; Eisenschitz, T.S.; Koerner, J. G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nov 1975. 43p. Dep. NTIS (US Sales Only) $4.00.

One defines constraint free electromagnetic $N–N^*_{\frac{3}{2}}$ transition form factors for general abnormal and normal parity transitions and relate them to multipole and helicity transition form factors. Possible parametrizations of the constraint free form factors are discussed, and various theoretically motivated simplifications are considered which are then compared to the available transition form factor data. If analyzed in terms of the constraint free form factors a very simple picture is obtained for the three leading resonances P_{33}, D_{13} and F_{15}. Namely, the qualitative features of the multipole structure of each resonance are governed by one coupling ratio each. The results of recent multipole analyses indicate that these coupling ratios are approximately the same in all three cases. The analysis supports the contention that the N–Δ form factor falls with one power faster asymptotically than that corresponding to canonical dipole behavior. (auth)

24495 (ORO-3992-245) DEEP INELASTIC SCATTERING IN A REGGEISED SYMMETRY MODEL. Harun ar Rashid, A. M. (Texas Univ., Austin (USA). Center for Particle Theory; Dacca Univ. (Bangladesh)). Feb 1976. 40p. Dep. NTIS $4.00.

The phenomena of deep inelastic electroproduction and nucleon Compton scattering at high energy are systematically investigated within the framework of a Reggeised symmetry model. Using duality as the essential theoretical concept, the high omega-behavior of the structure functions is derived from the Reggeisation prescription due to Van Hove and the low omega-behaviour is obtained from the dispersion relation approach due to Schwinger. Such a unified treatment avoids many ad hoc assumptions current in the literature and results in a simple phenomenological description of the virtual photon-nucleon scattering processes. (auth)

24496 (ORO-4856-47) GAUGE TRANSFORMATIONS AND QUANTUM MECHANICS (II): PHYSICAL INTERPRETATION OF CLASSICAL GAUGE TRANSFORMATIONS. Yang, K. H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1976. 45p. Dep. NTIS $4.00.

New gauges are introduced. The potentials, vector and scalar, in these gauges are obtained in closed forms by the Green's function method. These closed form solutions are explicitly expressed only in terms of the charge and current densities. The physical interpretation is on how potentials propagate from the charge and current densities. The Coulomb gauge and the Lorentz gauge are special cases of a new gauge, which is defined. It is called the complete alpha-Lorentz gauge. The scalar potential propagates at speed alpha c from the charge density for any positive alpha. When alpha is one, the usual solutions for the Lorentz gauge are recovered. When alpha is not one, results show that, in order to satisfy the requirement that electromagnetic fields be gauge invariant and in order to conform to Maxwell's interpretation that electromagnetic fields propagate at speed c from the charge and current densities (considering only the vacuum) the vector potential must contain two mathematically and physically independent gradient components. Furthermore, one such component must propagate at speed alpha c while the other must at speed c from charge and current densities. Discussions on the Coulomb gauge are based on the results obtained by letting alpha go to (positive) infinity. Guided by Maxwell's interpretation, a new decomposition of the vector potential is introduced in the Lorentz gauge into a longitudinal and a transverse component. For an arbitrary charge and current distribution, it is shown that the transverse component will generate all the fields only in the radiation zone. However, for a point charged particle, the transverse component only generates the "free fields" everywhere in the instantaneous rest frame of the charged particle. (auth)

24497 MEASUREMENT OF THE ELECTROMAGNETIC FORM FACTOR OF THE ETA MESON AND OF THE BRANCHING RATIO FOR THE ETA DALITZ DECAY. Jane, M. R.; Grannis, P.; Jones, B. D.; Lipman, N. H.; Owen, D. P.; Peterson, V. Z.; Toner, W. T. (Science Research Council, Chilton (UK). Rutherford Lab.); Bellamy, E. H.; Green, M. G.; Kirkby, J. Phys. Lett.; 59B: No. 1, 103-105(13 Oct 1975).

In an optical spark chamber experiment a sample of 80 eta Dalitz decays (eta $\to e^+e^-\gamma$) have been obtained and the eta electromagnetic form factor has been measured to be $F(X) = 1.0 - (0.22 \pm 0.45)X$, where $X = M^2_{e^+e^-}/M^2_\eta$, and the branching ratio $(\text{eta} \to e^+e^-\gamma)/(\text{eta} \to \pi^+\pi^-\pi^0) = (0.0082 \pm 0.0020)$. (NL)

24498 NEW UPPER LIMIT FOR THE BRANCHING RATIO FOR THE DECAY ETA $\to \pi^0e^+e^-$. Jane, M. R.; Grannis, P.; Jones, B. D.; Lipman, N. H.; Owen, D. P.; Peterson, V. Z.; Toner, W. T. (Science Research Council, Chilton (UK). Rutherford Lab.); Bellamy, E. H.; Green, M. G.; Kirkby, J. Phys. Lett.; 59B: No. 1, 99-102(13 Oct 1975).

The decay eta $\to \pi^0e^+e^-$ has been looked for in an optical spark chamber experiment at the Rutherford Laboratory. The observations are consistent with no events being seen and give an upper limit rate $(\text{eta} \to \pi^0e^+e^-)/\text{rate (eta} \to \text{all)} < 4.5 \times 10^{-5}$ (90% C. L.). (NL)

24499 SHADOWING IN NUCLEAR PHOTO-ABSORPTION: OFF-DIAGONAL TERMS. Ditsas, P.; Read, B. J.; Shaw, G. (Manchester Univ. (UK)). Nucl. Phys.; 99B: No. 1, 85-95(17 Nov 1975).

Off-diagonal terms, as required in the generalized vector dominance description of deep inelastic electron scattering and in vector meson photo- and electroproduction, are shown to be significant in the case of heavy nuclear targets. The consequences for shadowing in real and virtual photo-absorption are calculated, both for the simplest rho plus rho' (1600) ansatz, and in a full multichannel model. (NL)

24500 RADIATIVE DECAY OF VECTOR MESONS IN THE QUARK MODEL. Ono, S. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 14: No. 16, 569-571(20 Dec 1975).

An attempt is made to calculate the decay rates of vector mesons using the harmonic oscillator quark model wave function with the spring constant equal to 0.12 MeV/c. The results are shown for ideal mixing. It is seen that the overlap integral plays an important role in these processes. (JFP)

24501 ELECTRON- AND MUON–NUCLEUS ELASTIC SCATTERING: A SEMICLASSICAL APPROACH. Kim, Y. N. (Texas Technical Univ., Lubbock). Nuovo Cim.; 31A: No. 1, 100-108 (1 Jan 1976).

It is shown, by a semiclassical picture, that the effect of the difference in the charge radius of the electron and muon, if any, on the elastic e- and μ-nucleus scattering is too small to be observed experimentally at the present time. If any discrepancy is found in these scattering cross sections, it must be attributed to the nonelectrostatic origin. (auth)

24502 MONOPOLES AND THE HIGGS MODEL. Venturi, G. (Univ., Bologna). Nuovo Cim.; 31A: No. 1, 79-88(1 Jan 1976).

The introduction of magnetic charges in a Higgs Lagrangian is studied in the limit for which the gauge field becomes very massive. It is found that in such a case the scalar Higgs field may be confined to the string. Further the equivalent of the Dirac condition is found for the case of a point charge and a massive gauge field, and it is seen that there is no constraint between "electric"

and "magnetic" charges. Rather it appears that the world area traced out by the string on looping it around an electric charge is quantized. (auth)

24503 POLARIZATION CORRELATIONS DURING PHOTOPRODUCTION OF PION PAIRS ON PROTONS. Ibadov, R. M.; Sadykhov, F. S.; Mukhtarov, A. I. Dokl. Akad. Nauk Uzb. SSR; No. 4, 35-37(1975). (In Russian)

The photoproduction of pion pairs on polarized and nonpolarized targets by circularly polarized photon beams was studied on the basis of previously proposed models. The analysis showed that with increase of the energy of the incident photons the asymmetry maximum in the small-angle region is sharper whereas the polarization minimum of the recoil protons is displaced toward small angles. (JSR)

24504 OSCILLATING-FIELD MISALIGNMENT IN MAGNETIC RESONANCE. Allegrini, M. (CNR, Pisa, Italy); Arimondo, E. Nuovo Cim., 31B: No. 1, 12-18(11 Jan 1976).

The influence of a r.f. field component parallel to the static magnetic field is investigated for magnetic resonance in a two-level system. For the shift of the resonant field accurate analytical expressions are derived. A continued-fraction solution is presented to include relaxation. (auth)

24505 IS THERE A LINK BETWEEN GAUGE INVARIANCE, RELATIVISTIC INVARIANCE, AND ELECTRON SPIN. Kupersztych, J. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges, France). Nuovo Cim., 31B: No. 1, 1-11(11 Jan 1976).

Without any assumptions other than the theory of classical electrodynamics applied to the problem of a charged particle interacting with the field of an electromagnetic plane wave, an operator is derived which has no other significance than the motion of the spin of a Dirac particle, given by the solution of the Bargmann-Michel-Telegdi equation. It is shown that the motion of an electron and the motion of its spin in a plane wave are given by an operator of Lorentz type which has the remarkable property of being equivalent to a gauge transformation. (auth)

24506 JOINT STATISTICAL COUNT OF FREE- AND BOUND-ELECTRON STATES OF A SYSTEM OF ELECTRONS AND PROTONS. Wulff, H. Nuovo Cim., 31B: No. 1, 81-91(11 Jan 1976).

A joint statistical count results in the well known Maxwellian energy distribution function for free-electron states and a distribution function for bound states, which has not yet been given in the literature. From the latter function the well known distribution function for bound states, the Boltzmann factor, is to be derived in a simple manner as well as the law of mass action (the Saha equation) by combining the function for free states and the new one for bound states. The essential feature of this function is that it contains the degeneracy parameter like that of free electrons. (auth)

24507 SPIN STRUCTURE OF COMPTON SCATTERING AT HIGH ENERGIES. Grifols, J. A. (Univ., Barcelona). Lett. Nuovo Cim.; 14: No. 17, 622-626(27 Dec 1975).

Going back to the elastic channel and guided by previous experience in vector-meson photoproduction, an attempt is made to estimate possible effects arising from an s-channel helicity-nonconserving pomeron in the reaction $\gamma p \to \gamma p$ in experiments with polarized targets. It is noted that the experimental detection of the helicity-flip component in Compton scattering is more cumbersome than in ρ^0 photoproduction. (JFP)

24508 SIDEWISE DISPERSION RELATIONS AND STATIC CHARACTERISTICS OF ELECTROMAGNETIC AND WEAK BARYON–BARYON TRANSITIONS. Krive, I. (Kharkov State Univ.). Acta Phys. Pol., Ser.; B7: No. 1, 17-28(Jan 1976).

The method of sidewise dispersion relations is used for the calculation of anomalous magnetic moments (a. m. m.) and constants of "weak magnetism" of electromagnetic and weak $B(J^P = 1/2^+) \to B'(J^P = 1/2^+)$ transitions. The performed analysis shows that the values of a. m. m. of octet baryons calculated with the method mentioned above, and compared with the experimental data and the ratio of "weak magnetism" constants of different weak baryon-baryon transitions do not contradict the predictions of Cabibbo's model. (auth)

24509 COMPLEX ELECTROMAGNETIC FOUR-POTENTIAL AND THE CABIBBO–FERRARI RELATION FOR MAGNETIC MONOPOLES. Mignani, R.; Recami, E. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 30A: No. 4, 533-540(21 Dec 1975).

Within "extended relativity" one generalizes the Maxwell equations in terms of four-potentials for both ordinary and faster-than-light charges. One succeeds in giving a physical meaning to the complex electromagnetic four-potential (and to complex electromagnetic four-current, tensor and field), and in giving a new interpretation to the Cabibbo-Ferrari relation for magnetic monopoles. (auth)

24510 GRAVITON–ELECTRON VERTEX AND THE f^0 MESON DECAY WIDTH. Montufar, C. M. Notre Dame, IN; Univ. of Notre Dame (1975). 100p. University Microfilms Order No. 76-2335.

Thesis (Ph. D.).

It takes three form factors to describe the graviton-electron interaction. In the limit of zero momentum transfer these form factors essentially reduce to the mass of the electron. It is shown that under certain conditions the form factors of the graviton-electron vertex function vanish at high energies. One first develops the exact massless spin-2^+ propagators in terms of two spectral functions. Working in a covariant gauge, which requires the use of an indefinite metric, it is shown that the spectral functions are positive definite. One then extends a theorem of Lehmann, Symanzik, and Zimmermann, namely the vanishing of the pi-N vertex function at high energies, to the graviton-electron interaction. Also, using spin-2 techniques one calculates the differential and total cross sections for the photoproduction of the f meson in terms of the width of the f^0 decaying into two photons. (Diss. Abstr. Int., B)

24511 INTERPRETATION OF ELASTIC ELECTRON-DEUTERON SCATTERING AT LARGE MOMENTUM TRANSFER. Woloshyn, R.M. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. Lett. 36: No. 4, 220-222 (26 Jan 1976).

The meson-exchange-current contribution to the deuteron electromagnetic form factors is interpreted from a quark-interchange point of view. Introducing nucleon structure suggested by the quark model, the calculation of Chemtob, Moniz, and Rho is shown to be in qualitative agreement with recent experimental data. (auth)

24512 ELECTROMAGNETIC DECAY WIDTHS IN A RELATIVISTIC CHARMONIUM MODEL. Gunion, J.F. (University of Pittsburgh, Pittsburgh, Pennsylvania 15260); Li, L.F. Phys. Rev. D 13: No. 1, 82-86 (1 Jan 1976).

We consider a relativistic model of quark confinement incorporating both a linear large-distance potential and a Coulomb-like short-distance potential. Special emphasis is placed upon predictions for leptonic decay widths and the $2s-1p$ radiative transition of the charmonium model. We find that relativistic enhancement of the former force one to a situation in which the $2s-1p$ transition width is large. (auth)

24513 TWO-PHOTON DECAY OF THE PSEUDOSCALAR MESONS. Isgur, N. (Department of Physics, University of Toronto, Toronto, Ontario, M5S 1A7 Canada). Phys. Rev. D 13: No. 1, 129-132 (1 Jan 1976).

The two-photon decays of the pseudoscalar mesons are studied in terms of the fundamental quark-antiquark annihilation amplitude. The similarity of the pseudoscalars to parapositronium is stressed. In particular, it is shown that the atomic physics result for the decay width of parapositronium, modified in certain cases to accommodate strong-binding effects, is applicable to these hadrons and leads to values for their two-photon widths which are in accord with experimental results. (auth)

24514 GAUGE THEORY WITH CALCULABLE NEUTRON-PROTON-QUARK MASS DIFFERENCE. Wilkinson, D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. D 12: No. 12, 3897-3906 (15 Dec 1975).

A gauge theory of weak and electromagnetic interactions is presented, in which the neutron-proton-quark mass difference is finite and calculable. The model is a generalization to include strange particles of an $SU(2)_L \times SU(2)_R \times U(1)$ model suggested by Weinberg; neutral strangeness-changing processes are suppressed using the Glashow-Iliopoulos-Maiani mechanism, which introduces a fourth "charmed" quark P', in addition to the usual P, N, λ. Universality of semileptonic and leptonic weak interactions can easily, though not naturally, be achieved, and the model has the interesting prediction that the effective hadronic neutral current is purely vector. By imposing an additional discrete symmetry, a solution is obtained in which weak universality is natural, and the neutron-quark and proton-quark masses vanish in zero order. (auth)

Weak

24515 (CONF-7409140-P1) WEAK INTERACTIONS. Summer School on Particle Physics, Gif-sur-Yvette, France, 9–21 September 1974. Volume I. Cabibbo, N.; Iliopoulos, J.; Leite Lopes, J.; Maiani, L.; Musset, P.; Rubbia, C.; Turlay, R. (Institut National de Physique Nucleaire et de Physique des Particules, 75–Paris (France)). 1974. 380p. (In French and English)

Separate abstracts were prepared for the six papers presented. (JFP)

For abstracts of individual papers see: 24407–24409, 24488, 24516, and 24517.

24516 (CONF-7409140-P1, pp 1-175) WEAK INTERACTIONS: AN INTRODUCTION. Leite Lopes, J. (Univ., Strasbourg). 1974. (In French)

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In weak interactions. Vol. I.

A historical review is given for weak interaction theory, constructed initially in order to describe β decay processes and by analogy with electrodynamics. One can find step by step from experiment, principles and rules and their violation, as those of invariance, from agreement with spatial reflection and charge conjugation up to the formulation of the effective Lagrangian current–current and to the study of weak current structure. (JFP)

24517 (CONF-7409140-P1, pp 271-295) RECENT PROGRESS IN GAUGE THEORY. Iliopoulos, J. (Ecole Normale Superieure, Paris). 1974. (In French)

From summer school on particle physics; Gif-sur-Yvette, France (Sep 1974).

In weak interactions. Vol. I.

In this review of gauge theories of weak and electromagnetic interactions particular emphasis is placed on recent developments, such as asymptotic freedom, research on charm and color, or the speculation on the unification of all interactions. (JFP)

24518 (CONF-741181-P1, pp 128-147) NEUTRAL CURRENTS IN WEAK INTERACTIONS. Sarma, K. V. L. (Tata Inst. of Fundamental Research, Bombay). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

After a brief review of experiments on neutral currents in weak interactions, a discussion is presented of the analysis of inclusive reactions induced by neutrinos on hadron targets. (JFP)

24519 (CONF-741181-P1, pp 160-176) PARTON/LIGHT-CONE IDEAS AND THEIR CONFRONTATION WITH THE LATEST LEPTON–HADRON DATA. Roy, P. (Tata Inst. of Fundamental Research, Bombay). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

Parton and light-cone ideas are discussed in the light of the latest data on deep inelastic lepton–nucleon scattering and high energy e^+e^- annihilation into hadrons. Asymptotically free theories and scaling violations are also considered. (JFP)

24520 (ORO-3992-248) HYPERON DECAYS AND SPECTRUM GENERATING SU(3). Teese, R. B.; Boehm, A. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. Contract E(40-1)-3992. 19p. (CONF-760118-3). Dep. NTIS $3.50.

From symposium on mathematical physics; Mexico City, Mexico (5 Jan 1976).

The research program described in this review is aimed at describing the properties of relativistic one-hadron systems by an algebra of observables, in analogy to the nonrelativistic description of atoms. This formalism has recently been applied to the leptonic and semi-leptonic decays of pseudoscalar mesons, and was shown to be capable of predicting both the suppression of strangeness changing decays and the value of the form factor ratio xi in K/sub l_3/ decay. A preliminary description of the leptonic decays of hyperons indicates that second class matrix elements are predicted as a consequence of a precise formulation of SU(3) symmetry breaking. A chi^2-fit to the experimental data indicates that this preliminary model is an improvement over the usual Cabibbo model, and points the way for further theoretical work. It is hoped that this program will lead to a model for the leptonic decays of hadrons which improves upon the results of the Cabibbo model and which explains some of the assumptions of that model. (auth)

24521 (ORO-3992-249) SU(3) SYMMETRY IN LEPTONIC DECAYS OF PSEUDOSCALAR MESONS. Bohm, A.; Igarashi, M.; Werle, J. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. Contract AT(40-1)-3992. 8p. (CONF-760118-4). Dep. NTIS $3.50.

From symposium on mathematical physics; Mexico City, Mexico (5 Jan 1976).

A short report of the present status of SU(3) symmetry in leptonic decays of pseudoscalar mesons is given including some new results. All the more involved calculations are omitted. It is found that this model works quite well in the case of leptonic decays of pseudoscalar mesons. (JFP)

24522 BOUNDS FOR THE K_{l3} FORM FACTORS. Auberson, G.; Mahoux, G.; Simao, F. R. A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys.; 98B: No. 2, 204-214(3 Nov 1975).

A complete solution is given to a mathematical problem encountered in the search for bounds on the K_{l3} scalar form factor. Besides standard analyticity assumptions, the information used is, firstly, the Mathur-Okubo inequality derived from a chiral model, secondly the experimental low-energy $I = \frac{1}{2}$, S-wave, $K\pi$ phase shift. Upper and lower bounds are computed, compared with previous bounds, and found to be in agreement with recent experimental data. (NL)

24523 UNIVERSALITY AND THE WEAK NEUTRAL CURRENT. Herbert, J. M. (Kent Univ., Canterbury (UK)). Nucl. Phys.; 98B: No. 2, 276-284(3 Nov 1975).

The possibility that the weak neutral current displays both muon–electron and quark-lepton universality is considered. Such a model contains three parameters which are determined, within limits, from existing data on deep inelastic scattering of neutrinos off nucleons and elastic scattering of neutrinos off leptons. It is shown that such a model is consistent with other results on elastic neutrino-nucleon scattering and neutrino-induced production of single pions. (NL)

24524 ELECTRON–NUCLEON WEAK NEUTRAL CURRENT AND 0^--0^+ NUCLEAR ISOMERISM. Isgur, N. (Toronto Univ., Ontario (Canada). Dept. of Physics). Nucl. Phys.; 98B: No. 2, 329-348(3 Nov 1975).

Since one photon exchange is completely forbidden in processes of the type $1^- \rightarrow 1^+$ (l is a charged lepton) or any crossed version of such a process, weak neutral current effects are considerably enhanced. It is shown that 0^--0^+ nuclear isomers, if they exist, will accordingly exhibit strikingly large neutral current effects. In particular, the mono-energetic conversion electrons will have helicities h of the order of 25% which should be easily measurable. In certain favorable cases, the nuclear weak current matrix elements may be measured experimentally via the analogue β decay or electron capture so that measuring h will constitute a measurement of the electron's neutral vector current coupling constant. In any event, detection of h would prove the existence of an as yet unseen class of neutral currents. (NL)

24525 RIGHT-HANDED WEAK CURRENTS IN NEUTRINO SCATTERING. Barger, V.; Weiler, T. (Wisconsin Univ., Madison (USA). Dept. of Physics); Phillips, R. J. N. (Science Research Council, Chilton (UK). Rutherford Lab.). Phys. Lett.; 59B: No. 1, 56-60(13 Oct 1975).

Transition strengths of right-handed weak charged currents are investigated in deep inelastic neutrino scattering, exploiting the dominance of p,n valence quarks in the nucleon. The energy dependences of σ_t and the average quantities $\langle y \rangle$ and $\langle Q^2 \rangle$ are shown to provide sensitive measures of new quark production thresholds and right-handed currents in $\bar{\nu}N$ scattering. With this analysis, the present data give an upper bound on the right to left hand structure function ratio of $F_R^{\bar{\nu}N}/F_L^{\bar{\nu}N} \sim \frac{1}{2}$, above a threshold of W ~ 7.5 GeV. (NL)

24526 MEASUREMENTS ON TWO-PARTICLE CORRELATIONS AT THE CERN ISR. Castaldi, R. (CERN, Geneva). pp 219-233 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Correlations between charged particles and a photon emitted at intermediate and large angles are presented as a function of the transverse momentum of the photon. The correlation function between charged secondaries and a particle (π^-, K^-, $\bar{p}$, or n) produced in the fragmentation region is also investigated. (auth)

24527 ELASTIC NEUTRINO–NUCLEON SCATTERING AND NEUTRAL-CURRENT MODELS. Cordes, J. G.; Kiang, D.; Tsai, S. Y. (Dalhousie Univ., Halifax, Nova Scotia). Lett. Nuovo Cim.; 14: No. 17, 601-604(27 Dec 1975).

Starting from a general neutrino–quark neutral-current weak interaction and taking the SU(3) symmetry into account, an attempt is made to derive a formula which expresses the cross section ratio r for $\nu_\mu + p \rightarrow \nu_\mu + p$ and $\nu_\mu + n \rightarrow \mu^- + p$ interactions in

terms of certain parameters and then to compare the expected values of r for various neutral-current models proposed previously. (JFP)

24528 QUARK–PARTON MODEL RELATIONS MEASURING THE DIFFERENCE BETWEEN CHARMED- AND STRANGE-QUARK FRAGMENTATION INTO PIONS IN NEUTRINO EXPERIMENTS. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 15: No. 1, 1-6(3 Jan 1976).

The charmed quark is incorporated into the quark–parton model applied to the current fragmentation region. It is shown how within this model the difference between the strange-quark fragmentation function into charged pions and the corresponding fragmentation function of the charmed quark can be related to measurable quantities like particle distribution functions and average multiplicities. (JFP)

24529 PARTICLE RATIOS IN LEPTOPRODUCTION IN A SIMPLE PARTON MODEL. Cerny, V. (Comenius Univ., Bratislava). Lett. Nuovo Cim.; 14: No. 16, 583-586(20 Dec 1975).

A rough estimation is made of particle ratios for various particles in leptoproduction the current fragmentation region based on a model calculation. An attempt was made to use a model which includes all the usual parton model assumptions and is also specific enough to allow the caculations to be made without an additional experimental input. (JFP)

24530 QUARK MODELS AND RADIATIVE PION DECAY. Moreno, M.; Pestieau, J. (Institut de Physique Théorique, Université de Louvain, B-1348 Louvain-la-Neuve, Belgium). Phys. Rev. D 13: No. 1, 175-178 (1 Jan 1976).

In the framework of relativistic quark models, we consider the structure-dependent part of the decay $\pi^+ \to e^+\nu_e\gamma$ and evaluate the ratio, γ, of the axial-vector form factor to the vector form factor. For masses of the quarks much larger than the pion mass we find $\gamma \lesssim 1$. This is different from previous predictions, made in the static quark model, which yield $\gamma = 0$. If the pion is treated as a nucleon-antinucleon pair, $\gamma \cong 0.4$ is in better agreement with experiments. (auth)

24531 COMMENT ON THE INTERPRETATION OF THE J PARTICLE AS A CHARM-ANTICHARM BOUND STATE. Hagiwara, T.; Mohapatra, R.N. (Department of Physics, The City College of The City University of New York, New York, New York 10031). Phys. Rev. D 13: No. 1, 150-152 (1 Jan 1976).

Assuming that the 3.1-GeV resonance observed at SLAC and BNL is interpreted as a vector meson belonging to the $\underline{15} + \underline{1}$ representation of SU(4), we remark on its decay width to a lepton pair, using the first spectral-function sum rule for U(4) and the assumption of pole dominance. The observed leptonic decay width, $\Gamma(J \to ll)$, requires a charge assignment of the quarks, completely different from the conventional one. We propose another way to distinguish between the two assignments. (auth)

24532 DIRECT LEPTON YIELDS FROM VECTOR-MESON DECAY. Raychaudhuri, K.; Weisberg, H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. D 13: No. 1, 153-155 (1 Jan 1976).

Lepton yields from vector-meson decay for $p_T \lesssim 1$ GeV/c are reasonably well determined by existing vector-meson production data and are small compared with $l/\pi = 1 \times 10^{-4}$. A class of reasonable extrapolations to higher p_T gives yields that remain small, but a rise in l/π cannot be ruled out. Vector-meson polarization effects are discussed. (auth)

24533 CONTRIBUTIONS OF VECTOR-MESON DOMINANCE TO CHARMED-MESON PRODUCTION IN INELASTIC NEUTRINO AND ANTINEUTRINO INTERACTIONS. Einhorn, M.B.; Lee, B.W. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 13: No. 1, 43-49 (1 Jan 1976).

We discuss the contribution to neutrino-hadron interaction due to F^* dominance of the weak vector current, and we give quantitative estimates of the x and y distributions for the deep-inelastic cross section at various energies. Other contributions, such as the nonresonant continuum and axial-vector terms, have been qualitatively discussed as well. We compare our results with experimental data on single-muon and dimuon production. We also calculate the diffractive, "elastic" F^* production cross section. (auth)

24534 WHY COLOR FAILS TO SHOW IN ELECTROPRODUCTION AND NEUTRINO SCATTERING EXPERIMENTS. Pati, J.C.; Salam, A. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. Lett. 36: No. 1, 11-14 (5 Jan 1976).

We show that the suppression of color-brightening effects in leptoproduction is a general property of a class of spontaneously broken color-gauge theories, based on integer-charge quarks. (auth)

24535 VECTOR ANOMALY AND THE MAGNETIC AND QUADRUPOLE MOMENTS OF THE W BOSON. DeRaad, L.L. Jr.; Milton, K.A.; Tsai, W. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 12: No. 12, 3972-3977 (15 Dec 1975).

The requirement that no vector anomaly be present in the electromagnetic form factors of the W boson leads to superconvergence relations involving the corresponding moments. A consistent solution of these relations can be obtained by assuming that only the sidewise magnetic form factor is once-subtracted. The resulting static quantities, however, differ slightly from those determined by the n-dimensional calculation method. This discrepancy is traced to the fact that the latter results do not satisfy the above-mentioned superconvergence relations. (auth)

Strong (General)

Refer also to abstract 24421.

24536 (CONF-741181-P1, pp 103-127) LARGE TRANSVERSE MOMENTUM PHENOMENA IN HADRON–HADRON COLLISIONS. Chavda, L. K. (Indian Inst. of Tech., Bombay). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

A brief review is given of experimental results. Then the theoretical models with which one tries to interpret these data in terms of the internal structure of hadrons are reviewed. (JFP)

24537 (CONF-741181-P1, pp 148-159) GAUGE THEORIES. Mani, H. S. (Indian Inst. of Tech., Kanpur). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

An outline is given of the patterns that have emerged in the last two years of investigation. It is noted that the various requirements of weak interactions along with some restrictions needed for strong interactions seem to lead to a broad picture of strong interactions. It is pointed out that there seems to be some insight gained into the hadronic structure, though none of the arguments are compelling. (JFP)

24538 (COO-1545-165) DYNAMICAL REALIZATION OF BREAKING OF EXCHANGED DEGENERACY AND VIOLATION OF ZWEIG'S RULE. Pinsky, S. S.; Snider, D. R. (Argonne National Lab., Ill. (USA)). Aug 1975. 13p. (ANL-HEP-PR-75-37). Dep. NTIS $3.50.

A multiperipheral model that implements part of the Veneziano topological expansion and in which the cylinder correction breaks exchange degeneracy and produces Zweig's rule violation as well as a Pomeron above one is presented. In the negative charge conjugation channel the model is identical to the 0 meson model of Freund and Nambu if continued to a spin one pole on the daughter of the Pomeron. (auth)

24539 (KFKI-75-64) EXTENDED PARTICLE MODEL FOR HADRONS WITH SURFACE TENSION. Gnadig, P.; Hasenfratz, P.; Kuti, J.; Szalay, A. S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 29p. (CONF-750636-3). Dep. NTIS (US Sales Only) $5.00.

From fifth international conference on neutrino science; Balaton, Hungary (16 Jun 1975).

An extended particle model with quark confinement is proposed. A membranous closed surface under surface tension is introduced to confine the colored vector gluon fields to a finite region of space /Poincaré stresses/. Quarks as colored point particles are coupled to the colored gluon fields so that they become confined to the inside of the membranous bag. The canonical quantization of the model is discussed and several applications are presented. (auth)

24540 (ORO-3992-247) RELATIVISTIC ROTATORS: A QUANTUM MECHANICAL DE SITTER BUNDLE. Boehm, A. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1976. Contract E(40-1)-3992. 17p. (CONF-760118-2). Dep. NTIS $3.50.

From symposium on mathematical physics; Mexico City, Mexico (5 Jan 1976).

If de Sitter fiber bundle over space time is the classical picture of hadrons then for a quantum mechanical description one has to generalize the concept of a principal fiber bundle to a bundle that contains the representation of the group of motion. This idea is related to the relativistic rotator model, and the radius of the de Sitter fiber is determined from the experimental hadron spectrum. (auth)

24541 (RL-75-172) SIMPLE GEOMETRICAL APPROACH TO PARTICLE PRODUCTION IN COLLISIONS WITH NUCLEI.

Dias de Deus, J. (Science Research Council, Chilton (UK). Rutherford Lab.). Nov 1975. 17p. Dep. NTIS (US Sales Only) $3.50.

It is argued that hadron collisions with nuclei are similar to hadron-hadron collisions, having similar properties for the impact parameter distributions and the leading particle spectra. The relevant existing high energy data, including the universality of multiplicity distributions and the possibility of geometrical scaling in reactions with nuclei, are easily understood in the framework of geometrical models by extending to p-nucleus collisions what was learned about impact parameter and leading particles in p-p collisions. The questions of forward-backward correlations and photo and electroproduction are briefly discussed. (auth)

24542 IMPACT PARAMETER REPRESENTATION OF THE LEADING PROTON SPECTRUM IN THE DIFFRACTIVE REGION. Barshay, S. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). Phys. Lett.; 59B: No. 1, 63-66(13 Oct 1975).

Recent experiment indicates that there is no limiting value for the pion invariant inclusive cross section at x = 0 at the highest energies reached by the CERN intersecting storage rings. It is first noted that a recently proposed integral representation of the leading proton spectrum is physically equivalent to representing this spectrum in terms of very narrow multiplicity distributions from each initial impact parameter, with a single factorizable function for the average multiplicity at any impact parameter b, $\langle n(s,b/R(s))\rangle = N(s)\bar{n}(b/R(s))$. It is then observed that, in this approach, the explicit form for the scaled part of the spectrum for mod(x) < 0.97 and $p_T \sim 0$ depends essentially upon the assumed asymptotic form for the growth of average multiplicity with energy s. The data do not exclude the empirical possibility of N(s) proportional to s^{ϵ}, $\epsilon < 1/4$. (NL)

24543 MESON SPECTROSCOPY WITH THE ω SPECTROMETER. Mandelli, L. (CERN, Geneva). pp 295-308 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A short summary of the ω experimental program is given. Expected results in the field of boson resonances are discussed and some preliminary data shown. (auth)

24544 LOCAL COMPENSATION OF QUANTUM NUMBERS AND SHADOW SCATTERING. Krzywicki, A. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). pp 309-321 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A theoretical discussion of the hypothesis of local compensation of quantum numbers and of the implications of this local compensation for the shadow scattering of hadrons are given. (auth)

24545 HADRONIC INTERACTIONS IN BAG MODELS. Squires, E. J. (Univ. of Durham, Eng.). pp 329-336 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

One considers how the interaction between two hadrons can be evaluated if the hadrons are made of noninteracting quarks confined by a boundary condition. (auth)

24546 STATIONARY PHASE APPROACH TO HIGH ENERGY HADRONIC SCATTERING. Fried, H. (Brown Univ., Providence); Moreno, H. pp 351-360 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

High energy hadronic scattering as described by a simplified theory involving nucleons, neutral vector mesons, and scalar pions interacting via a Lagrangian density is considered. It is found that one may expect several simple features to emerge in the high energy limit and a nice relation between elastic and inelastic scattering can be established. This is possible due to the use of the stationary phase technique of approximation to some of the general expressions that are derived. (JFP)

24547 HOW TO LEARN ABOUT HADRON DYNAMICS FROM AN UNDERLYING QUARK–GLUON FIELD THEORY. Farrar, G. R. (California Inst. of Tech., Pasadena). pp 369-383 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A solution is proposed to the problem of how physics can be abstracted from a fundamental quark-gluon field theory for hadrons, without having solved the problem of confinement. (auth)

24548 EXPONENTIAL DECAY LAW AND IRREVERSIBILITY OF DECAY AND COLLISION. Alda, V. (Matematicky Ustav CSAV Prague (Czechoslovakia)); Kudrat, V.; Lokajicek, M. V. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav). Apl. Mat.; 19: No. 5, 307-315(Oct 1974).

A description of the decay (or collision) process is given using the pair $\{K, U(t)\}$ where $K = K_A \oplus K_0$ is the Hilbert space of state vectors (K_A corresponds to the unstable particle and K_0 to its decay products) and U(t) is the evolution operator determining the time evolution of the physical system. The significance of various assumptions related to the structure of space K and to the properties of operator U(t) were studied.

24549 MULTIPARTICLE PRODUCTION IN PARTICLE-NUCLEUS COLLISIONS AT HIGH ENERGIES. Berlad, G.; Dar, A.; Eilam, G. (Physics Department, Technion-Israel Institute of Technology, Haifa, Israel). Phys. Rev. D 13: No. 1, 161-165 (1 Jan 1976).

A simple model is proposed for multiparticle production in high-energy particle-nucleus collisions. The production process factorizes into a product of nuclear properties and measured particle-particle collision properties. Most results are insensitive to nuclear structure details. Good agreement between experiment and theory is obtained. An important implication for high-energy particle-physics research is pointed out. (auth)

24550 PRODUCTION OF ϕ, ψ, AND CHARMED HADRONS IN STRONG INTERACTIONS. Gaisser, T.K. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081); Halzen, F. Phys. Rev. D 13: No. 1, 171-174 (1 Jan 1976).

We show that an SU(4) quark-gluon model is a specific realization of a scaling rule proposed by the authors for understanding hadronic production of heavy particles, including the recently discovered ψ particles. The model leads to predominantly associated production of ϕ and ψ (e.g., pairs). We emphasize that tests of the charmonium picture for ψ particles can be made independently by looking to see whether ϕ mesons are predominantly associatively produced. (auth)

24551 NORMAL HADRONIC DECAYS OF ψ AND ψ'. Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 36: No. 3, 117-120 (19 Jan 1976).

A phenomenological model for decays of ψ and ψ' into normal hadronic modes is proposed. This model can explain the decay rate $\Gamma(\psi \to \pi\rho)$ as well as the puzzlingly large rate $\Gamma(\psi \to \varphi\pi^+\pi^-)$ in comparison to $\Gamma(\psi \to \omega\pi^+\pi^-)$. It also predicts many other relations which can be easily tested experimentally. (auth)

Strong (Baryon No. = 0)

24552 (DESY-75/46) IDENTIFICATION OF A POSSIBLE $\chi(3.55)$. Daboul, J.; Krasemann, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nov 1975. 10p. Dep. NTIS (US Sales Only) $3.50.

We argue in favor of an identification of the $\chi(3.55)$ as the paracharmonium 2^1S_0, η_c'. The masses of the charmonium 2^{++} and 1^{+-} states are predicted, and estimates are given for the radiative decays of the ψ' via η_c and η_c'. (auth)

24553 (LPC-75-02) $\bar{p}p$ PARTIAL-WAVES ANALYSIS AT 400 AND 500 MeV/c. Laloum, M. (College de France, 75-Paris). [nd]. 10p. Dep. NTIS (US Sales Only) $3.50.

A partial-waves analysis of the $\bar{p}p$ elastic scattering, at fixed momenta 400 and 500 MeV/c (lab.) is performed. It is mainly assumed that most of the amplitude comes from orbital momenta $l \leq 2$. Although polarization values are lacking, adjustment to available experimental data leads to a restricted number of solutions, because of strong unitarity constraints. (auth)

24554 (LPC-75-03) ANTIPROTON CROSS SECTIONS IN A CONTINUUM OF ENERGY. Laloum, M. (College de France, 75-Paris). [nd]. 8p. Dep. NTIS (US Sales Only) $3.50.

A simple and quite accurate method is proposed allowing a continuous energy-dependent normalization of antiproton cross sections, down to the immediate vicinity of stop-point. (auth)

24555 SELF-CONSISTENT DIFFRACTION IN THE MULTIPERIPHERAL MODEL. Ball, J. S. (CERN, Geneva). pp 121-130 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Self-consistency requirements in the multiperipheral (MP) model are reviewed. With a simple assumption regarding the vanishing of the triple-Pomeron vertex, a nonlinear integral equation is obtained for the asymptotic scattering amplitude. A previously obtained exact solution to this equation is given and a comparison of this model with the ISR elastic scattering data is made. A satisfactory fit to that data is obtained, but the values of the parameters indicate that, within this model, ISR energies are far from being asymptotic. (auth)

24556 IMPACT PARAMETER STRUCTURE OF MULTIBODY PROCESSES. Michael, C. (Univ. of Liverpool). pp 323-327 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Estimates of the impact parameter structure of many body production processes can be obtained from exclusive data on the transverse momentum distribution. Applications were made to diffraction dissociation, proton-antiproton annihilation and n-body final states in K^-p interactions. (auth)

24557 DOES IT MATTER THAT THE A_1 DOES NOT EXIST. Kane, G. L. (Univ. of Michigan, Ann Arbor). pp 337-349 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Some arguments are reviewed for expecting axial vector mesons (especially the A_1) to exist, the (now rather compelling) evidence that the A_1 does not exist is summarized, and what some consequences might be for the quark model, for chiral symmetry, and several other areas of particle physics are discussed. (auth)

24558 PRODUCTION OF PSI AND CHARMED VECTOR MESONS. Kalman, C. S. (Concordia Univ., Montreal). Lett. Nuovo Cim.; 14: No. 17, 605-610(27 Dec 1975).

The form of the cross sections for the production of ψ particle and charmed vector mesons is found. The production cross sections for various meson-baryon and meson-meson interactions are tabulated. (JFP)

24559 CONFINEMENT OF QUARKS AND VECTOR GLUONS IN A SUPERCONDUCTING PHASE. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 15: No. 2, 49-56(10 Jan 1976).

In the context of theories dealing with confinement the question is asked whether it is possible to use from the outset the boundary conditions for a superconducting phase in the system of Green functions of the quark field and to save thereby the introduction of not well understood scalars. Calculating in the lowest approximation, it is shown that this possibility can indeed exist. For simplicity one considers only one kind of quark described by the spinor field. One starts with a given Lagrangian density containing a quartic self-interacting term. It is concluded that there is a possibility for a strong spin-spin interaction between the valence quarks. This would account for the large π-ρ mass difference. (JFP)

24560 ARE THERE ACCUMULATION POINTS OF POLES OF THE N ANTI N SCATTERING AMPLITUDE. Barmawi, M. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 15: No. 1, 22-26(3 Jan 1976).

The study of the ladder graph with an insertion for $N\bar{N}$ scattering with a Yang-Mills vector-meson exchange is outlined. It is found that no accumulation point of poles is found in the $N\bar{N}$ scattering. The factor which gives rise to this accumulation point of poles in the ϕ_6^3 theory becomes a constant in the $N\bar{N}$ scattering. The spin plays an important role in this phenomenon. (JFP)

24561 CHARMED QUARK DISCOVERY IN ANTINEUTRINO-NUCLEON SCATTERING. Vigier, J. P. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 15: No. 2, 41-48(10 Jan 1976).

The treatment of charmed quark discovery in antineutrino-nucleon scattering concerns a rather economical scheme which contains the minimum number of quantum numbers needed at present to explain strong, weak, and electromagnetic interactions. It provides a possible line of attack into the still unanswered question of where one should look for quarks, but should be considered only as a heuristic possibility until further consequences can be evaluated. (JFP)

24562 HELICITY ANALYSIS OF DIFFRACTIVELY PRODUCED STATES IN THE RELATIVISTIC QUARK MODEL. Klosinski, J. (Lebedev Inst. of Physics, Moscow). Acta Phys. Pol., Ser.; B7: No. 1, 69-72(Jan 1976).

The results of an analysis of possible helicity states, based on the relativistic quark model, for diffractively produced mesonic systems are reported. The model explains approximate t-channel helicity conservation (TCHC) in pion diffractive dissociation. (auth)

Strong (Baryon No. = 1)

24563 (CONF-741181-P1, pp 177-187) INHERENT AMBIGUITIES IN THE DETERMINATION OF PHASE SHIFTS. Atkinson, D. (Tata Inst. of Fundamental Research, Bombay). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

The discussion of inherent ambiguities in the determination of phase shifts includes total and differential cross sections and polarization for π^+ p interactions and the method of construction of ambiguities. (JFP)

24564 (DESY-75/47) DOES x(2.8 GeV) FAVOR CHARM OR COLOR. Kobayashi, T. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nov 1975. 9p. Dep. NTIS (US Sales Only) $3.50.

The possibilities of the newly discovered particle with mass 2.8 GeV belonging to the charm scheme or to the color scheme are discussed. It is pointed out that crucial tests for this problem are measurements of the decay of x(2.8) into $2\pi^+2\pi^-$ (or 4 pseudoscalar mesons) and the ratio $\Gamma(x(2.8) \to V\gamma)/\Gamma(x(2.8) \to 2\gamma)$. (auth)

24565 STRANGENESS EXCHANGE IN HIGH ENERGY INTERACTIONS. Mihul, A.; Angelescu, T. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett.; 59B: No. 1, 106-108(13 Oct 1975).

The average strangeness transfer computed for the K^+-p interactions on the basis of the existing experimental data does not change appreciably in the 4 to 16 GeV/c beam momentum range, being negative for K^+p and positive for K-p interactions. Comparison with the electric charge transfer is made. (NL)

24566 PION EXCHANGE AND THE UNIVERSAL IMPACT PARAMETER HYPOTHESIS. Humble, S.. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys.; 98B: No. 2, 267-275(3 Nov 1975).

In order to describe pion exchange reactions a modification to the "b-universality" hypothesis is proposed which simply relates the impact parameter profiles of helicity amplitudes for different values of net helicity-flip. This proposal is shown to give an excellent quantitative fit to the $\pi^-p \to \rho^0n$ and $\pi^-p \to f^0n$ data at 17.2 GeV/c. It also provides a natural explanation for the presence and size of the necessary absorptive cut corrections. (NL)

24567 STRUCTURE OF AMPLITUDES OF TWO-BODY REACTIONS. Contogouris, A. P. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). pp 167-182 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A method combining fixed-t dispersion relations with an (incomplete) set of experimental data and leading to amplitude analyses is presented and applied to certain two-body nondiffractive reactions. Characteristic regularities of the resulting amplitudes are pointed out. A comparison to F E S R leads to an understanding of the t-structure of the real parts. (auth)

24568 TOWARDS A SOLUTION FOR THE HELICITY DEPENDENCE OF SCATTERING AMPLITUDES. Schrempp, B.; Schrempp, F. (CERN, Geneva). pp 183-188 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2–14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Derivative rules, relating all s channel helicity amplitudes of a two-body reaction to a single one, are discussed and tested. (auth)

24569 ARE CONFORMAL MAPPING POLYNOMIALS REALLY OPTIMAL ANALYTIC PARAMETRIZATIONS OF THE SCATTERING AMPLITUDES. Langbein, W. (Univ., Kaiserslautern, Ger.). Nuovo Cim., 30A: No. 4, 653-681(21 Dec 1975).

The problem of analytic extrapolation of the scattering amplitudes in the presence of error-affected data is studied. It is shown that stabilization by a theoretical norm ϕ or by fits with suitable finite-dimensional analytic parametrizations are related in a simple way. The second method is a special case of the former with ϕ homogeneous of degree zero in the fitted functions. The remaining properties of the analytic extrapolation depend on further details of ϕ and also on the number N of terms necessary to get an acceptable fit to the data. The theoretical norm ϕ can be simply related to the stability measure used, while the dependence on N turns extrapolation into a nonlinear problem, so that one is left with numerical tests. For this purpose rational functions prove to be more suitable than conformal mapping polynomials as is demonstrated for the πN invariant amplitudes. (auth)

24570 MINIMAL REGGE MODEL FOR MESON–BARYON SCATTERING; DUALITY, SU(3) AND PHASE-MODIFIED ABSORPTIVE CUTS. Egli, S. E. Iowa State Univ. (1975). 70p. University Microfilms Order No. 76-1835.

Thesis (Ph. D.).

A model is presented which incorporates economically all of the modifications to simple SU(3)-symmetric dual Regge pole theory which are required by existing data on $0^- \frac{1}{2}^+$ yields $0^- \frac{1}{2}^+$ processes. The basic assumptions are noexotics duality, minimally broken SU(3) symmetry, and absorptive Regge cuts phase-modified by the Ringland prescription. One first describes qualitatively how these assumptions suffice for the description of all measured reactions, and then presents the results of a detailed fit to 1987 data points for 18 different reactions. (Diss. Abstr. Int., B)

24571 DOUBLE STATISTICAL TENSORS FOR RESONANCES PRODUCED BY POLARIZED PHOTONS. Gorczyca, B. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Acta Phys. Pol., Ser. B; 4: 35-42(1973).

Double statistical tensors for resonances produced by polarized photons are presented. The joint decay distribution in double resonance production is expressed in terms of four double statistical tensors ${}^{(\alpha)}T, \alpha = 0, 1, 2, 3$. The tensor ${}^{(0)}T$ describes the process induced by unpolarized photons, while the tensors ${}^{(1)}T$, $i = 1, 2, 3$ correspond to the processes induced by linearly or circularly polarized photons. The quark model predictions for the decay distributions of resonances photoproduced in the reaction $\gamma B \rightarrow VB^*$ are rewritten in terms of four statistical tensors ${}^{(\alpha)}T, \alpha = 0, 1, 2, 3$. (auth)

24572 INDEPENDENCE OF THE QUARK MODEL CLASS (A) RELATIONS FOR THE REACTIONS $0^- \frac{1}{2}^+ \rightarrow 1^- \frac{3}{2}^+$. Jaroszewicz, Z. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Acta Phys. Pol., Ser. B; 4: 21-25(1973).

It is shown that class (a) relations following from the additive quark model for the reaction $0^- \frac{1}{2}^+ \rightarrow 1^- \frac{3}{2}^+$ are not independent because some of the joint statistical tensors satisfy bilinear kinematical relations. (auth)

24573 TEST OF THE ASSUMPTION OF EQUAL PHASES FOR ALL THE HELICITY AMPLITUDES IN THE PROCESS $0^- \frac{1}{2}^+ \rightarrow 1^- \frac{3}{2}^+$. Karczmarczuk, J. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki); Zalewski, K. (Institute of Nuclear Physics, Krakow (Poland)). Acta Phys. Pol., Ser. B; 4: 27-33 (1973).

The assumption of equal phases for all the helicity amplitudes is implicit in many models. Supplementing it by the class (a) relations predicted by the quark model we find that the 19 parameters necessary to describe the decay distribution in the process $0^- \frac{1}{2}^+ \rightarrow 1^- \frac{3}{2}^+$ depend on four independent parameters only. Since the quark model predictions are well supported by experiment, we interpret our result as a test for the assumption of equal phases for the helicity amplitudes. The test is used to analyze the available experimental data. (auth)

24574 MULTIPLICITY OF NEUTRAL PIONS IN HIGH ENERGY COLLISIONS. Bardadin-Otwinowska, M.; Bialkowska, H.; Gajewski, J.; Gokieli, R.; Otwinowski, S.; Wojcik, W. Acta Phys. Pol., Ser. B; 4: 561-571(1973).

We study the experimental characteristics of the π^0 production in high energy π^- p and pp colisions. The observed features of charged multiplicity distribution and neutral pion production are described by a phenomenological model which assumes a Czyżewski-Rybicki formula for the total multiplicity distribution and the hypothesis of isospin independence. (auth)

24575 BACKWARD PRODUCTION IN $\pi^- p \rightarrow p\pi^+\pi^-\pi^-$ AT 8 GeV/c. Abashian, A.; Eisenstein, B.; Hansen, J.D.; Mollet, W.; Morris, G.R.; Nelson, B.; O'Halloran, T.; Orr, J.R.; Rhines, D.; Schultz, P.; Sokolsky, P.; Wagner, R.G. (University of Illinois at Urbana-Champaign, Urbana, Illinois 61801); Watson, J.; Gelfand, N.M.; Buttram, M. Phys. Rev. D 13: No. 1, 5-21 (1 Jan 1976).

We have studied backward baryon and meson production in $\pi^- p \rightarrow p\pi^+\pi^-\pi^-$ at 8.0 GeV/c using a streamer chamber triggered by the detection of a fast forward proton. Our data sample (1227 events) displays prominent $N^*\rho$ and N^*f quasi-two-body production. These states are investigated with regard to the peripheral nature of the production mechanism and sequential decay of the excited baryon and meson systems. The quasi-two-body production of $N^*\rho$ and N^*f intermediate states is consistent with u-channel proton exchange as the dominant production mechanism. In the $\pi^+\pi^-\pi^-$ mass distribution we observe a 3- to 4-standard-deviation enhancement at $M_{3\pi} = 1897 \pm 17$ MeV/c^2 with full width at half maximum $= 110 \pm 82$ MeV/c^2, but find no evidence for backward A_1 or A_2 production. We observe $\Delta^{++}(1232)$ production in the $p\pi^+$ effective mass distribution. (auth)

24576 HOW STRONG ARE THE POMERON DECOUPLING THEOREMS? Jones, C.E.; Misheloff, M.N. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68588). Phys. Rev. D 13: No. 1, 95-98 (1 Jan 1976).

We investigate how close to one a Pomeron pole can be before the decoupling mechanisms make the total pion-pion cross section too small to be consistent with that deduced from experiment by means of factorization. Our method employs energy-momentum sum rules for singly and doubly inclusive cross sections. By assuming pion pole dominance in the forward direction, we are able to eliminate the triple-Pomeron coupling, which leaves an inequality involving only the Pomeron-pole location and the pion-Pomeron coupling. From this we are able to conclude that the decoupling mechanism is exceedingly weak. (auth)

24577 SPIN-FLIP DYNAMICS AND INCLUSIVE PROCESSES. Levintov, I.I. (Institute of Theoretical and Experimental Physics). JETP Lett. 22: No. 4, 115-117 (20 Aug 1975).

A connection between the sign of the imaginary part of the amplitude with spin flip in elastic πN scattering at small momentum transfers and the ratio of the cross sections of the inclusive processes of the type $\pi N \rightarrow NX$ and $\pi N \rightarrow \Delta X$ is established on the basis of the unitarity conditions in the s-channel. (auth)

24578 DIFFRACTION-MINIMUM MECHANISM IN ELASTIC HADRON SCATTERING. Vall, A.N.; Enkovskiĭ, L.L.; Struminskiĭ, B.V. (Institute of Theoretical Physics, Ukrainian Academy of Sciences). JETP Lett. 22: No. 3, 77-79 (5 Aug 1975).

We discuss the mechanism of diffraction minimum in elastic scattering of hadrons. The dip is the result of unitary effects of the dipole-pomeron model and corresponds to absorption at small values of the impact parameter. Absorption is characterized by the constant $\kappa = \lambda - 1/b$, where λ is determined from the total cross section and b is the slope parameter of the diffraction peak. The use of this connection as well as of the results of the quark model enables us to predict the position of the diffraction minimum in K^+p scattering. (auth)

Strong (Baryon No. ≥ 2)

24579 (CEA-CONF-3165) CORRELATIONS BETWEEN NEUTRAL AND NEGATIVE PIONS IN pp INTERACTIONS AT 69 GeV/C Boratav, M.; Loskiewicz, J.; Touchard, A. M. (Paris-11 Univ., 91–Orsay (France). Lab. de Physique Nucleaire et Hautes Energies). 1975. 13p. (CONF-750654--18). Dep. NTIS (US Sales Only) $3.50.

From high energy particle physics divisional conference of EPS; Palermo, Italy (23 Jun 1975).

From 3798 γ's observed in Mirabelle, the 4.8m HBC at Serpukhov, one obtains the dependence on n of $\langle n_0 \rangle$ and f_2^0, the correlation parameter. Also the inclusive f_2^0 and f_2^{-0} parameters and information concerning KNO-scaling. (auth)

24580 ANALYSIS OF 1 GeV PROTON SCATTERING ON D AND ^{4}He IN A NON-EIKONAL APPROACH. Gurvits, S. A.;

Alexander, Y.; Rinat, A. S. (Weizmann Inst. of Science, Rehovoth (Israel)). Phys. Lett., B; 59: No. 1, 22-26(13 Oct 1975).

A recently formulated theory for multiple hadron scattering is applied to 1.7 GeV/c scattering on D and ^{4}He. Agreement is obtained for pD up to θ_{CM} approximately 90° and for p^{4}He over the entire range measured (θ_{CM} < approximately 65°). (NL)

24581 CONSTRUCTION OF A UNITARY ANALYTIC AMPLITUDE FOR THE SCATTERING OF SPIN-½ PARTICLES. Manolessou-Grammaticou, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., B; 98: No. 2, 298-328(3 Nov 1975).

The existence, the uniqueness and the construction of unitary analytic amplitudes are studied for spin ½-½ scattering in the framework previously introduced by Atkinson-Mahoux-Yndurain for spin 0-0, and spin 0-½ scattering. (NL)

24582 COHERENT DIFFRACTION DISSOCIATION OF PROTONS ON DEUTERIUM AT HIGH ENERGIES. Olsen, S. L. (Univ. of Rochester, NY). pp 59-66 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

The p-d inelastic scattering at small momentum transfers was measured by detecting the slow recoil deuterons from a deuterium gas jet target. It was found that for low masses the cross section exhibits structure and is dominated by an enhancement at $M_x^2 \sim 1.9$ (GeV)^2. In the higher mass region, $M_x^2 \gtrsim 5.0$ (GeV)^2, it was found that the differential cross section $d^2\sigma/dtdM_x^2$ varies only slowly with energy and behaves to a good approximation as $1/M_x^2$. (auth)

24583 PRELIMINARY RESULTS ON DOUBLE DIFFRACTION DISSOCIATION AND DOUBLE ISOBAR PRODUCTION IN THE REACTION pp → $(p\pi^+\pi^-)(p\pi^+\pi^-)$ STUDIES WITH SFM AT THE CERN ISR. Goggi, G. (Pavia Univ., Italy). pp 67-74 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Preliminary data are presented on the reaction pp → $(p\pi^+\pi^-)(p\pi^+\pi^-)$ studied with the SFM at the CERN ISR, at three energies $\sqrt{s}$ = 23 GeV, 31 GeV, 53 GeV. Mass spectra of the systems $(p\pi^+n^-)$ show evidence for the double isobar production pp → N(1688) N(1688). Differential cross sections $d\sigma/dt$ are given. Comparison of slopes and mass distributions for double and single dissociation seems to support the hypothesis of factorization of diffractive cross sections. (auth)

24584 COMMENTS ON THE SYSTEMATICS OF POMERON EXCHANGE REACTIONS. Maor, U. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). pp 131-139 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th Moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Some of the experimental properties of high energy elastic p-p scattering are reassured in search for possible systematics. The different b-space profiles obtained for elastic and inelastic diffraction are understood once s-channel unitarity corrections are implemented. (auth)

24585 GEOMETRICAL SCALING IN PROTON-PROTON SCATTERING. Kroll, P. (Univ., Karlsruhe, Ger.). pp 141-151 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

The influence of the real part of the elastic amplitude on geometrical scaling is discussed. It is shown that the inelastic overlap function scales above 50 GeV and not the elastic amplitude. Consequences of this result for elastic scattering are discussed. (auth)

24586 GEOMETRICAL VERSUS CONSTITUENT INTERPRETATION OF LARGE ANGLE EXCLUSIVE SCATTERING. Schrempp, B.; Schrempp, F. (CERN, Geneva). pp 189-194 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

It is pointed out that the large angle pp → pp data suggest an exponential behavior in p_T modulated by a regular oscillation in p_T more naturally than a power law s^{-N}. It is argued that these effects are due to a manifestation of the same geometrical length scale R ≃ 1 fermi which is known to control small angle scattering. (auth)

24587 INCLUSIVE CROSS SECTION FOR p + n → p + X BETWEEN 50 AND 400 GeV. Sannes, F. (Rutgers-The State Univ., New Brunswick, NJ). pp 195-202 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Inclusive cross sections were measured for the reaction p + d → p + X in the region 0.15 < |t| < 0.39 GeV^2, 100 < s < 750 GeV^2 and 0.80 < x < 0.92 using the acceleration ramp and deuterium gas jet target at Fermilab. These measurements are combined with earlier measurements of p + p → p + X to obtain inclusive cross sections for p + n → p + X. (auth)

24588 INDEPENDENT CLUSTER PRODUCTION AND THE KNO SCALING FUNCTION. de Groot, E. H. (CERN, Geneva). pp 257-264 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A single component independent cluster model, based on a certain smoothness property of the amplitudes involved, is presented. The KNO multiplicity distribution function, the momentum distribution of the leading particles and clusters, as well as the relations among them are deduced. (auth)

24589 FINAL STATE CHARACTERISTICS OF CENTRAL pp COLLISIONS AT 28.5 GeV/c. Schuebelin, P. (Brookhaven National Lab., Upton, NY). pp 265-293 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Results are presented from an experiment of inelastic central pp collisions at 28.5 GeV/c observed by the multiparticle Argo spectrometer system (MASS). Characteristics of final states are given as a function of transverse momentum to a forward proton or π^+ meson over a considerable range of the allowed phase space (.3 GeV/c < $P_\perp$ < 2 GeV/c, 1.3 GeV < MM < 6.5 GeV). (auth)

24590 TRIPPLE-REGGE TOTAL CROSS SECTIONS. Moriarty, K. J. M.; Tabor, J. H. (Royal Holloway Coll., Surrey, Eng.). Lett. Nuovo Cim.; 15: No. 1, 17-21(3 Jan 1976).

Calculations are presented for the proton-proton inclusive interaction triple-Regge total cross sections. (JFP)

24591 STRONG-INTERACTION DEPENDENCE OF γ-RAY CIRCULAR POLARIZATION IN THERMAL NEUTRON-PROTON PHOTOCAPTURE. Epstein, G. N. (Oxford Univ.). Lett. Nuovo Cim.; 15: No. 2, 60-64(10 Jan 1976).

The possibility is examined that the NN strong force may also conspire to enhance the p.v. circular polarization of γ rays from thermal neutron-proton photocapture. The dispersion relations for the γ ray circular polarization and oxygen-16 alpha decay width enhancements are shown for various weak-interaction models. The results show that one can obtain considerable enhancement of the circular polarization by using a supersoft NN force with a tensor component which is weak at short range. (JFP)

24592 POSSIBLE ORIGIN OF OSCILLATIONS AND EXPONENTIAL FALL-OFF IN HIGH ENERGY LARGE ANGLE pp SCATTERING. Islam, M. M. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 14: No. 17, 627-632(27 Dec 1975).

It is suggested that the oscillations in high energy large angle pp scattering are due to a sudden change in absorption from b < R to b > R seen by the large-angle scattering process in the impact parameter plane (R = diffraction radius). It is suggested

that the exponential fall-off of the large-angle amplitude is due to the existence of a nucleon core, which can be identified as a bag. It is concluded that the exponential fall-off can be regarded as evidence for the coherent scattering of quarks in one nucleon off those of the other. (JFP)

24593 DOUBLE-POMERON EXCHANGE CROSS SECTIONS WITH A CENTRAL 2π VERTEX. Buchl, R. A. (Pahlavi Univ., Shiraz, Iran); Manesis, E. K. Lett. Nuovo Cim.; 14: No. 16, 597-600(20 Dec 1975).

The cross section behavior for the reaction $pp \rightarrow pp + 2\pi$ is investigated assuming double-pomeron exchange. Predictions are also given for $\pi p \rightarrow \pi p + 2\pi$ and $Kp \rightarrow Kp + 2\pi$. (JFP)

24594 SOLUTION OF THE SKORNYAKOV–TER-MARTIROSYAN EQUATION FOR QUARTET nd-SCATTERING. Adburakhmanov, A.; Akhmadkhodzhaev, B. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 4, 26-27(1975). (In Russian)

The Skornyakov–Ter-Martirosyan equation for the amplitudes of nd scattering with total spin $S = -3/2$ and total orbital momentum $l = 0$ was solved. The solution shows the dependence of the real part of the quartet phase on the energy of the incident neutron. (JSR)

24595 THE REACTION $n+p \rightarrow d+\gamma$ AND THE ISOSPIN STRUCTURE OF THE STRANGENESS: CONSERVING NONLEPTONIC WEAK HAMILTONIAN. Perez, M.A. (The Rockefeller University, New York, New York 10021). Ann. Phys. (N.Y.) 94: No. 2, 374-390 (Oct 1975).

The circular polarization P_γ and angular asymmetry α of the photons emitted in the reaction $n+p \rightarrow d+\gamma$ are computed in a covariant formalism within the framework of a composite-particle theory of the deuteron. The most important magnetic and electric dipole transition amplitudes in this radiative capture process are determined through a low-energy theorem. It is found that some of the proposed models for the strangeness-conserving nonleptonic weak Hamiltonian give variations on the ratio α/P_γ of one or two orders of magnitude. (auth)

Particle Invariance Principles and Symmetries

24596 PARITY NONCONSERVATION IN THE HYDROGEN ATOM. Lewis, R. R.; Williams, W. L. (Michigan Univ., Ann Arbor (USA). Harrison M. Randall Lab. of Physics). Phys. Lett., B; 59: No. 1, 70-72(13 Oct 1975).

The possibility is investigated of observing parity nonconservation with a metastable hydrogen atom beam by analyzing two effects which should permit detection of the 2S-2P admixture predicted by the Weinberg model. (NL)

24597 SU_6 AND SUPERSYMMETRY. Nandi, S. (Univ. of Chicago). Nuovo Cim.; 31A: No. 1, 159-162(1 Jan 1976).

It is shown that the SU_6 symmetry obtained by Salam and Strathdee from a supersymmetry cannot be identified with the usual SU_6 rest symmetry of the quark model. (auth)

General

Refer also to abstract 25064.

24598 FOUR-DIMENSIONAL POSITION OPERATOR, COHERENT STATES AND REPRESENTATIONS OF THE CONFORMAL GROUP. Haba, Z. (Univ., Wroclaw). Nuovo Cim., 30A: No. 4, 567-588(21 Dec 1975).

It is shown that the representation space of the conformal group $SO_{4,2}$ is the Bargmann-Segal space of coherent states $|w_\mu\rangle$ of the non-Hermitian position operator $\bar{w}_\mu^+$. The states $|w_\mu\rangle$ are coherent in the usual sense of minimal uncertainty of x_μ and p_μ. The real part of $\bar{w}_\mu^+$ gives the Hermitian position operator x_μ. Both operators fulfil the canonical commutation relations and are covariant under the conformal group. The imaginary part of $\bar{w}_\mu^+$ describes the dispersion of position. The metric operator G connecting $\bar{w}_\mu$ with its adjoint $\bar{w}_\mu^+$ gives the scalar product for various representations of the conformal group. (auth)

24599 SPONTANEOUS BREAKDOWN OF SYMMETRIES AND NEW DEGREES OF FREEDOM. Saller, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim., 30A: No. 4, 541-566(21 Dec 1975).

Spontaneous break-down of a symmetry shows that this symmetry has operator and constant c-number aspects. The separation of these two parts gives rise to an appearance of new degrees of freedom which are relevant for large distances – for a small quantitative break-down – and become irrelevant for small distances. These probably general features will be illustrated for the case of an isospin SU_2 fermion theory. In this model the spontaneous break-down of SU_2 leads to the appearance of hypercharge and a strongly broken $SU_2 \times U_1$ with local octet representations and hence implies only SU_3 multiplets with triality zero. (auth)

24600 NONET BOSON-MASS FORMULA IN SU(4) AND THE WIDTH OF THE $\eta_c(0^-)$. Takasugi, E.; Oneda, S. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 13: No. 1, 70-73 (1 Jan 1976).

It is argued that Schwinger's nonet mass formula is a more general mass relation than the ideal nonet mass formulas for any 16-plet bosons of the SU(4) group. The explicit limiting procedure by which the old SU(3) result is recovered from SU(4) is shown. The width of η_c (0^-) could be large depending on the assignment of the ninth 0^{-+} meson.

24601 STUDY OF $(3, 3^*) \oplus (3^*,3) \oplus (6, 6^*) \oplus (6^*,6)$ AND LINEAR AND BILINEAR $(3, 3^*) \oplus (3^*,3)$ CHIRAL-SYMMETRY BREAKING IN A LINEAR σ MODEL. Geddes, H.B.; Graham, R.H. (Department of Physics, University of Toronto, Toronto, Ontario, Canada M5S 1A7). Phys. Rev. D 13: No. 1, 56-69 (1 Jan 1976).

Two chiral symmetry-breaking schemes are considered within the context of a linear SU(3) σ model. In the first the symmetry-breaking terms are constructed from the usual linear (in the fields) $(3, 3^*) \oplus (3^*,3)$ contribution together with bilinear combinations belonging to the $(6, 6^*) \oplus (6^*,6)$ representation of SU(3) $\times$ SU(3). In the second scheme a combination of linear and bilinear $(3, 3^*) \oplus (3^*,3)$ terms is employed. The pseudoscalar mesons (π,K,η,η') and scalar mesons $(\epsilon,\kappa,\sigma,\sigma')$ are assigned to the $(3, 3^*) \oplus (3^*,3)$ representation in this model which is used to describe their mass spectra, various scalar meson decays, $\eta' \rightarrow \eta\pi\pi$, and the $\pi\pi$ and πK scattering lengths. With the addition of isospin-violating terms to the Lagrangian additional, electromagnetic effects can be taken into account. In each of the symmetry-breaking schemes considered it is found that a two-parameter form in which the linear $(3, 3^*) \oplus (3^*,3)$ contribution is SU(2) $\times$ SU(2) -invariant and the bilinear contribution is SU(3)-invariant is about as successful as the usual two-parameter linear $(3, 3^*) \oplus (3^*,3)$ form. (auth)

24602 DIHEDRAL SYMMETRY AND CHARGE CONJUGATION. Okubo, S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 12: No. 12, 3835-3837 (15 Dec 1975).

The charge conjugation C and the parity P are assumed to generate a finite group without assuming any *a priori* commutation or anticommutation relation. The group then generated is the dihedral group D_n (n being even) which has two-dimensional irreducible representations. This implies that we could have, in principle, elementary particles with parity and charge-conjugation doublet structure. (auth)

24603 UNIFIED GAUGE THEORIES WITH RIGHT-HANDED CURRENTS AND HEAVY FERMIONS. Mohapatra, R.N. (Department of Physics, City College of the City University of New York, New York, New York 10031). Phys. Rev. D 13: No. 1, 113-121 (1 Jan 1976).

Gauge models with heavy fermions and right-handed currents are discussed based on the gauge groups $SU(2)_A \times U(1) \times SU(4)$, $SU(2)_A \times SU(2)_B \times SU(4)$, and $SU(4) \times SU(4)$ and are constructed so as to lead to the $\Delta I = 1/2$ rule. $SU(4) \times SU(4)$ is advocated as the ultimate unifying gauge group of nature, and it is shown how at various stages of spontaneous breakdown both the $SU(2)_A \times SU(2)_B \times SU(4)$ and $SU(2)_A \times U(1) \times SU(4)$ groups manifest themselves. We also show that CP violation takes an interesting complexion in these models and leads to exactly the relations $\eta_{+-} \simeq \eta_{00}$ in $K_L \rightarrow 2\pi$ decays. Furthermore, we show that the magnitude of CP violation is related to gauge interactions that violate the heavy quark degeneracy. (auth)

24604 MASS FORMULA FOR NONETS. Isgur, N. (Department of Physics, University of Toronto, Toronto, Ontario, Canada). Phys. Rev. D 13: No. 1, 122-124 (1 Jan 1976).

The relation between the masses and mixing angle in a nonet of mesons is studied in a simple quark-gluon picture. We find that both the splitting of $\mu_\eta{}^2$ from $\mu_\pi{}^2$ and the departure of θ_P from θ_{ideal} are due to annihilation forces. Mass formulas which describe the masses in a nonet in terms of two parameters are derived and found to be in good agreement with observed masses for the 0^{-+}, 1^{--}, and 2^{++} nonets. (auth)

Applications (Electromagnetic and Weak)

24605 (ISS-P-75/10) CP VIOLATION IN PURELY LEFT-HANDED WEAK INTERACTIONS. Maiani, L. (Istituto Supe-

riore di Sanita, Rome (Italy). Laboratori di Fisica). 10 Oct 1975. 14p. Dep. NTIS (US Sales Only) $3.50.

In a model with six quarks and pure V-A weak interactions CP violation can be introduced in weak currents by spontaneous breaking. The resulting milliweak model is shown to lead uniquely, with good approximation, to the results of the superweak theory both for K decays and for the neutron electric dipole moment. (auth)

24606 KINEMATIC AND SYMMETRY STRUCTURE OF $e^+e^- \to$ HADRON PAIRS. Close, F. E. (European Organization for Nuclear Research, Geneva (Switzerland)); Cottingham, W. N. (Bristol Univ. (UK)). Nucl. Phys., B; 99: No. 1, 61-84(17 Nov 1975).

The kinematic singularity and constraint free amplitudes for $e^+e^- \to$ two particles which can have arbitrary spins are obtained in a simple closed form. The relationships of these amplitudes with the usual multipole form factors are given. It is noted that $SU(6)_w$ and tests of ideas based on the Melosh transformation are liberated from their γN and πN arena and can be confronted with arbitrary targets and excitations. The matrix elements for arbitrary meson pairs are then derived, rates are computed for pseudoscalar and vector meson production, and some tests of symmetry breaking mechanisms proposed. Extension to $SU(4)[SU(8)_w]$ broken in the masses enables estimates of charmed particle production rates to be obtained. General features of πR final states suggest that scaling violation at small x may be connected with threshold phenomena as channels open up. A subtle difference between space-like and time-like regions is highlighted. (NL)

24607 GAUGE MODELS WITH RIGHT-HANDED CURRENTS, NEUTRINO INTERACTIONS, AND K_L-K_S MASS DIFFERENCE. Branco, G.; Hagiwara, T.; Mohapatra, R.N. (Department of Physics, The City College of the City University of New York, New York, New York 10031). Phys. Rev. D 13: No. 1, 104-112 (1 Jan 1976).

We discuss weak interaction models with new right-handed charm changing currents and $\Delta I = 1/2$ rule within the $SU(2) \times U(1) \times G$ and $SU(2)_A \times SU(2)_B \times SU(4)$ gauge theory framework and point out that $\Delta S = 2$ transitions do not provide at present too much of a constraint on these models. We suggest that neutral-current interactions and high-energy neutrino cross sections will test the validity of these theories. (auth)

24608 SPONTANEOUS BREAKING OF ISOTOPIC SYMMETRY IN $K \to 2\pi$ DECAYS. Paziashvili, I.V. (Physics Institute, Georgian Academy of Sciences). JETP Lett. 22: No. 3, 87-88 (5 Aug 1975).

It is shown that allowance for spontaneous isospin nonconservation leads to weak transitions with $\Delta T = 3/2$ and explains the observed ratio of the widths of the decays $K^+ \to \pi^+\pi^0$ and $K^0_1 \to \pi^+\pi^-$. (auth)

Scattering Theory

Refer also to abstract 25067.

24609 REGGEIZATION IN YANG-MILLS THEORIES. Tyburski, L. (Illinois Univ., Urbana (USA). Dept. of Physics). Phys. Lett., B; 59: No. 1, 49-52(13 Oct 1975).

The high energy fermion-fermion scattering amplitude is calculated in Yang-Mills field theory through sixth order in the coupling constant, and it is found that the amplitude Reggeizes. The result is simpler than and qualitatively different from an earlier published calculation. (NL)

24610 INCONSISTENCY OF LOGARITHMICALLY GROWING CROSS SECTIONS WITH REGGE BEHAVIOR OF NON-VACUUM-EXCHANGE AMPLITUDES. Jones, C. E.; Misheloff, M. N. (Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics). Phys. Lett., B; 59: No. 1, 53-55(13 Oct 1975).

Using general theoretical considerations, it is shown that if total cross sections are to increase asymptotically like $(\log s)^\beta$ then high-energy non-vacuum exchange processes cannot be governed by simple factorized Regge behavior. (NL)

24611 DUAL ANALYTIC MODEL FOR THE POMERON. I. Kobylinskii, N. A.; Martynov, E. S. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 20: No. 10, 1626-1632(Oct 1975). (In Russian)

The dual analytic model for the four-point amplitude with the pomeron singularity in the vacuum channel is suggested for a case when the pomeron is simple and double pole. Existence of two types of double P-pole is shown. Properties of the pomeron trajectory and exotic trajectories dual to it are discussed. (auth)

24612 ELASTIC SCATTERING IN THE REGGEON CALCULUS AT ISR ENERGIES. Capella, A. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France); Tran Thanh Van, J.; Kaplan, J. pp 85-92 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th Moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

A very brief review is given of some important aspects of the Reggeon Calculus. Also a perturbative approach relevant at present energies and its application to elastic scattering are considered. (auth)

24613 HOW MUCH CAN WE TRUST THE REGGEON CALCULUS. DeTar, C. E. (CERN, Geneva). pp 93-99 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Some questions are raised regarding the generality of recent solutions of the Reggeon calculus near $J = 1$ and their implications for the high energy behavior of the elastic scattering amplitude. (auth)

24614 HIGH-ENERGY SCATTERING AS A CRITICAL PHENOMENON. Savit, R. (CERN, Geneva). pp 101-119 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Asymptotic (large s, small t) scattering can be studied as a critical phenomenon, akin to the infrared behavior of massless field theories, or the study of phase transitions in statistical mechanics. The Reggeon calculus provides a framework for the discussion. The important concept of universality is described, and it is suggested that the asymptotic behavior of scattering amplitudes may be independent of the details of the physics. Lattice and field theoretic methods for the calculation of critical exponents are explained, and results are presented. Finally, phenomenological implications for present energies are outlined. (auth)

24615 DOES THE POMERON OBEY GEOMETRICAL SCALING. Martin, A. (CNRS, Marseille). pp 153-158 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Tests of the validity of the geometrical scaling hypothesis are reviewed. (auth)

24616 IMPACT PARAMETER REPRESENTATION WITHOUT HIGH ENERGY, SMALL-ANGLE LIMITATION. Islam, M. M. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). pp 361-367 of Proceedings of the Tenth Recontre de Moriond. Volume I. Phenomenology of Hadronic Structure. Conference Held at Meribel-les-Allues, France, March 2-14, 1975. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris (1975).

From 10th moriond meeting; Meribel-les-Allues, France (2 Mar 1975). See CONF-750309-P1.

Using Watson-Sommerfeld transform the impact parameter representation of the scattering amplitude is shown to be valid for all physical energies and scattering angles. It is also shown to be valid for all physical energies and scattering angles. It is also shown how the direct channel Regge poles enter in the impact parameter amplitude. (auth)

24617 CONTINUITY OF THE S-MATRIX. Narnhoffer, H. (Bell Labs., Murray Hill, NJ). Nuovo Cim.; 30B: No. 2, 254-266 (11 Dec 1975).

The continuity of the S-matrix is shown especially for singular potentials, long-range potentials and screening. (auth)

24618 SCATTERING THEORY WITH DISSIPATIVE INTERACTIONS AND TIME DELAY. Martin, P. A. (Laboratoire de Physique Theorique, Lausanne, Switzerland). Nuovo Cim.; 30B: No. 2, 217-238(11 Dec 1975).

The general formalism of scattering theory with dissipative interactions is presented from the time-dependent viewpoint. A definition of time delay is proposed in this framework, generalizing that given for simple scattering systems. The time delay is expressed by a formula which reduces to that of Eisenbud and Wigner when there is no absorption. (auth)

24619 ABOUT THE NUMBER OF BOUND STATES FOR A VERY GENERAL POTENTIAL. Eltzalde, E. (Univ., Barcelona). Nuovo Cim.; 31A: No. 1, 151-158(1 Jan 1976).

A potential which saturates Cohn and Calogero's independently derived upper bound on the number of bound states for a monotonic potential is found, thus showing that this bound is the best possible in quite a strict sense. (auth)

24620 COVARIANCE, CAUSALITY, AND THE REFINED INFINITE-MOMENTUM LIMIT. Abdel-Rahman, A.M. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 12: No. 12, 3983-3993 (15 Dec 1975).

The refined infinite-momentum limit approach is used in the derivation of sum rules for the real parts of current-particle forward scattering amplitudes. The sum rules are based on covariance, causality, and fixed-q^2 unsubtracted dispersion relations in ν for the amplitudes. The fixed-mass sum rules so obtained are found to include those of the light-cone algebra. For amplitudes where the unsubtracted-dispersion-relation assumption is doubtful, the results are shown to be unaltered if once-subtracted dispersion relations are assumed instead. Convergence of the sum rules and inclusion of class-II contributions are also discussed. (auth)

24621 RIGOROUS PHASE-MODULUS CORRELATIONS FOR FORWARD SCATTERING AMPLITUDE AT HIGH ENERGIES. Fischer, J.; Kolář, P. (Institute of Physics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia); Vrkoč, I. Phys. Rev. D 13: No. 1, 133-149 (1 Jan 1976).

Starting from the basic results of axiomatic field theory a series of new asymptotic theorems for the symmetric $F_S(E)$ and the antisymmetric $F_A(E)$ forward scattering amplitudes are derived, E being the laboratory energy. The spins are neglected in the present paper. Assuming that the phase of F_S or F_A is asymptotically bounded within a certain range of values the corresponding bounds on $|F_S|$ or $|F_A|$, respectively, are obtained. Further, we show that certain conditions on the ratio $\mathrm{Re}F_S(E)\mathrm{Im}F_S(E)$ and on the signs of $\mathrm{Re}F_S(E)$ and $\mathrm{Im}F_S(E)$ for large enough energies can be formulated as criteria for the asymptotic behavior of the symmetric total cross section $\sigma_S(E)$. Analogous results are obtained for the antisymmetric forward scattering amplitude. Finally, useful necessary and sufficient conditions for the asymptotic rise or boundedness of $\sigma_S(E)$ and $\sigma_A(E)$ are derived. The results obtained are discussed in light of existing high-energy models and high-energy experiments. (auth)

24622 DEPENDENCE OF THE OFF-ENERGY-SHELL T MATRIX ON THE TOTAL THREE-MOMENTUM. Heller, L.; Bohannon, G.E. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545); Tabakin, F. Phys. Rev. C 13: No. 2, 742-748 (Feb 1976).

The Bakamjian-Thomas form of relativistic potential theory is used to derive a constraint on the off-energy-shell two-body T matrix elements. This is an equation which specifies the dependence of these matrix elements on the total three-momentum. While other formulations lead to different constraints, it is argued that this one is the most convenient. The distinction between this formula and the (irrelevant) notion of Lorentz transforming an off-energy-shell matrix element is discussed. A critical comparison is made with several formulas which have appeared in the literature in connection with the problem of scattering a π meson by a nucleus. (auth)

PHYSICS (LOW-TEMPERATURE)

Superconductivity

Refer also to abstracts 23660, 23690, 23693, 23717, 23721, 23727, 23748, 23749, 23752–23757, 23765, 23781, 23782, and 23795–23797.

24623 (ISS-P-75/7) MAGNETIC BEHAVIOR OF FIRST KIND SUPERCONDUCTING FILMS IN THE INTERMEDIATE THICKNESS REGION. Rogani, A.; Tabet, E. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 10 Jun 1975. 21p. Dep. NTIS (US Sales Only) $3.50.

The Ginzburg–Landau equations are solved for first kind superconducting films for thicknesses equal to or greater than the coherence length. Now the knowledge of the order parameter allows calculation of the parallel critical fields H_{cF} as a function of temperature and specimen thickness. Finally the theoretical values for H_{cF} are compared with the existing experimental data for tin films at various temperatures and thicknesses. 3 figures. (auth)

24624 PINNING IN SUPERCONDUCTORS WITH ATTRACTIVE AND REPULSIVE INTERACTION DEFECT-FLUX LINE. Takacs, S. (Electrotechnical Inst., Bratislava). Czech. J. Phys.; 25: No. 10, 1155-1175(1975).

Some results of the statistical theory of pinning are illustrated as well as the processes which lead to the existence of volume pinning force, and some quantities determining the pinning and other effects in type II superconductors are calculated by means of a model potential for both attractive and repulsive interactions between individual defects and individual flux lines. For some of these quantities (e.g., the volume pinning force) in superconductors with line defects perpendicular to the flux lines, large differences with respect to the shape and character (attractive, repulsive) of the interaction potential are found, whereas other quantities (e.g., the maximum reversible displacement of the flux line lattice, the force on the flux line lattice in the reversible regime) are rather little dependent on the shape and the character of the interaction potential. (auth)

24625 THEORY OF THE SUPERCONDUCTING PROXIMITY EFFECT BELOW THE TRANSITION TEMPERATURE. Silvert, W. (Dalhousie Univ., Halifax, Nova Scotia). Solid State Commun.; 17: No. 9, 1137-1139(1 Nov 1975).

The form of the low-temperature theory of the superconducting proximity effect depends on whether the non-linear terms are assumed to depend only on the local value of the gap or on its average value over some finite range. The local assumption leads to smaller values of the gap and to unphysical results at low temperatures. The effect of non-locality is significant even in the Ginsburg–Landau regime. (auth)

24626 COLLECTIVE MODES IN CHARGED SUPERCONDUCTORS NEAR T_c. Bray, A. J. (Univ. of Maryland, College Park); Schmidt, H. Solid State Commun.; 17: No. 9, 1175-1178 (1 Nov 1975).

The dynamics of charged superconductors is described within a phenomenological model. It exhibits near T_c a screened propagating mode, which represents high frequency second sound. The damping is due to friction, to the conversion of normal to superfluid, and diffusion. (auth)

24627 SURFACE PLASMONS IN LAYERED STRUCTURES AND THEIR ROLE IN SUPERCONDUCTIVITY. Economou, E. N. (Virginia Univ., Charlottesville); Ngai, K. L. Solid State Commun.; 17: No. 9, 1155-1159(1 Nov 1975).

The contribution of surface plasmons to electron-electron interaction is examined by calculating the effective Coulomb repulsion μ in the case of periodically spaced conducting planes separated by an insulator of dielectric constant ϵ_i. Substantial reduction in μ is obtained when $\epsilon_i \gg 1$. (auth)

24628 MODELING JOSEPHSON JUNCTIONS. McDonald, D.G.; Johnson, E.G.; Harris, R.E. (National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. B 13: No. 3, 1028-1031 (1 Feb 1976).

The current-voltage characteristic of a current-biased junction is calculated using the Werthamer theory. In contrast with the voltage-biased model large zero-frequency currents exist at 0 °K at all bias voltages below the energy gap and the Riedel peak is directly displayed. The effect of capacitance on the *I-V* curve is described and the form of the subharmonic energy-gap structure is calculated using the Mattis-Bardeen model for the superconducting electrodes. (auth)

24629 SUM RULES FOR THE CONDUCTIVITY OF SUPERCONDUCTING FILMS. Furuya, K.; Zimerman, A.H. (Instituto de Física Teórica, São Paulo, São Paulo, Brazil); Villani, A. Phys. Rev. B 13: No. 3, 1357-1358 (1 Feb 1976).

Infinite sets of sum rules are written for the difference between the complex conductivities in the superconducting and normal states. (auth)

24630 CORRECTNESS OF THE L. D. LANDAU THEORY OF THE INTERMEDIATE STATE. Landau, I.L.; Sharvin, Yu.V. (Institute for Physical Problems, Academy of Science of United Soviet Socialists Republic, Moscow 117334, United Soviet Socialists Republic). Phys. Rev. B 13: No. 3, 1359-1360 (1 Feb 1976).

The thermodynamics of the intermediate state is discussed. The experimental proof of the applicability of the L. D. Landau intermediate-state theory for the case of a plate in an inclined magnetic field is given. (auth)

24631 FLUCTUATIONS AND QUANTUM INTERFERENCE IN WEAKLY COUPLED SUPERCONDUCTING SYSTEMS. Khlus, V.A.; Kulik, I.O. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 20: No. 3, 283-288 (Mar 1975).

A study is made of the effects of quantum interference in weakly coupled superconducting systems in an external magnetic field, allowance being made for fluctuations. The circulating supercurrent is found as a function of the applied magnetic field for a weakly coupled ring when the coupling is comparable in magnitude with the thermal energy. The current–voltage characteristic for a superconducting quantum interferometer is found and it is shown that the amplitude of the steps formed in the current–voltage characteristic under the influence of external irradiation is an oscillating function of the flux of the applied magnetic field with a period equal to the flux quantum. (auth)

24632 PHOTOEFFECT IN A JOSEPHSON JUNCTION. Aronov, A.G.; Spivak, B.Z. (Nuclear Physics Institute, USSR Academy of Sciences). JETP Lett. 22: No. 4, 101-102 (20 Aug 1975).

It is shown that when a tunnel junction consisting of two superconductors with different energy gaps is illuminated, an absolute resistance is produced and leads to generation of an alternating voltage on the junction. (auth)

24633 EFFECT OF SPIN-ORBIT INTERACTION ON THE KNIGHT SHIFT OF NORMAL AND SUPERCONDUCTING SMALL PARTICLES. Shiba, H. (Tokyo Univ.). J. Low. Temp. Phys.; 22: No. 1/2, 105-119(Jan 1976).

The temperature dependence of the Knight shift is studied for normal as well as superconducting small particles. The discreteness of the energy levels and the spin–orbit coupling due to the particle surface are taken into account. The theory is capable of explaining the size and temperature dependence of experimental data on Cu and superconducting Sn particles. The magnitude of the spin–orbit interaction is estimated for these particles by comparing the experimental results with the theory. (auth)

24634 PHYSICAL METALLURGY OF SUPERCONDUCTION. Bitler, W. R. (Pennsylvania State Univ., University Park). Earth Miner. Sci.; 44: No. 6, 45-46(Mar 1975).

A brief review of current understanding of superconductors and their behavior is presented. (SDF)

PHYSICS (NUCLEAR)

24635 (ANL-75-34) ANALYSIS OF (n,2n) CROSS-SECTION MEASUREMENTS FOR NUCLEI UP TO MASS 238. Davey, W. G.; Goin, R. W.; Ross, J. R. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 191p. Dep. NTIS $8.50.

All suitable measurements of the energy dependence of (n,2n) cross sections of all isotopes up to mass 238 have been analyzed. The objectives were to display the quality of the measured data for each isotope and to examine the systematic dependence of the (n,2n) cross section upon N, Z, and A. Graphs and tables are presented of the ratio of the asymptotic (n,2n) and nonelastic cross section to the neutron-asymmetry parameter (N-Z)/A. Similar data are presented for the derived nuclear temperature, T, and level-density parameter, alpha, as a function of N, Z, and A. This analysis of the results of over 145 experiments on 61 isotopes is essentially a complete review of the current status of (n,2n) cross-section measurements. (auth)

24636 (BARC-799) VAN DE GRAAFF LABORATORY PROGRESS REPORT. Bhatia, M. S. (comp.). (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). 1975. 66p. Dep. NTIS (US Sales Only) $4.50.

Research progress in nuclear physics at the 5.5 MeV Van de Graaff accelerator at Bombay is reported. An analysis is given of machine operation and performance. (SDF)

24637 (BARC-831) PROGRESS REPORT ON NUCLEAR DATA ACTIVITIES IN INDIA, XI. Balakrishnan, M. (comp.). (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). 1975. 79p. Dep. NTIS (US Sales Only) $6.00.

The eleventh progress report on Nuclear Data Activities in India covers the work done during the calendar year 1974. Apart from the work done in the field of nuclear fission the major thrust of work in India is directed towards basic Nuclear Physics research both theoretical and experimental. The experiments predominantly involve charged particle reactions or level scheme studies. However during the current year a small program has been started with a view to assess the feasibility for measuring neutron capture data on ^{233}Th between 0.1 and 2 MeV to 5% accuracy. It is hoped to evolve this program into a more extensive data measuring and evaluation program for Thorium cycle data which may involve collaboration between a few laboratories in India as well as Bangladesh. A short summary of this preliminary work is given. The total number of CINDA entries sent to the Nuclear Data Section of the International Atomic Energy Agency during the period of report is 15. The liaison activity with computer program library (CPL) of the NEA was continued. (auth)

24638 (BNL-20700) ROLE AND USE OF NUCLEAR THEORIES AND MODELS IN PRACTICAL EVALUATION OF NEUTRON NUCLEAR DATA NEEDED FOR FISSION AND FUSION REACTOR DESIGN AND OTHER NUCLEAR APPLICATIONS. Prince, A. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 132p. (CONF-751220-1). Dep. NTIS $6.00.

From meeting on the use of nuclear theory in neutron nuclear data evaluation; Trieste, Italy (8 Dec 1975).

A review of the various nuclear models used in the evaluation of neutron nuclear data for fission and fusion reactors is presented. Computer codes embodying the principles of the relevant nuclear models are compared with each other and with experimental data. The regions of validity and limitations of the conceptual formalisms are also included, along with the effects of the numerical procedures used in the codes themselves. Conclusions and recommendations for future demands are outlined. 15 tables, 15 figures, 90 references. (auth)

24639 (CONF-741259-P17B) PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM, BOMBAY, DECEMBER 27-31, 1974. Volume 17B. Nuclear Physics. (Dept. of Atomic Energy Commission, Bombay (India)). 1974. 313p. Department of Atomic Energy, Bombay.

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974).

Separate abstracts appear in Nuclear Science Abstracts for each of 92 conference papers. (SDF)

For abstracts of individual papers see: 23350, 23384, 23423, 23424, 23891, 23908, 23917, 23918, 24290, 24664-24668, 24680-24684, 24731-24736, 24747-24761, 24789-24795, 24802-24813, 24842-24850, 24858, 24859, 24872-24877, and 24903-24918.

24640 (COO-3464-17) FINAL REPORT FOR THE PROJECT ENTITLED NUCLEAR STRUCTURE STUDIES. Preiss, I. L. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Dept. of Chemistry). Dec 1975. Contract AT(11-1)-3464. 28p. Dep. NTIS $4.00.

A final progress report is presented for research in photonuclear reactions, decay schemes, heavy ion reactions, and angular distributions in transfer reactions for ^{14}N and ^{12}C with ^{115}In. (SDF)

24641 (INDC-19/U) TECHNICAL MINUTES OF THE SEVENTH INDC MEETING, LUCAS HEIGHTS, 7-11 OCTOBER 1974. Benzi, V. (comp.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Sep 1975. 103p. (CONF-7410144- (Absts.)).

From 7th INDC meeting; Lucas Heights, Australia (7 Oct 1974).

Technical minutes of the International Nuclear Data Committee in Vienna October 1973 are reported. Technical information presented and discussed at the meeting is outlined. (SDF)

24642 (LA-6168-MS) CROSS-SECTION METHODOLOGY IN SIMMER. Soran, P. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-eng-36. 15p. Dep. NTIS $4.50.

The cross-section methodology incorporated in the SIMMER code is described. Data base for all cross sections is the ENDF/B system with various progressing computer codes to group collapse and modify the group constants which are used in SIMMER. Either infinitely dilute cross sections or the Bondarenko formalism can be used in SIMMER. Presently only a microscopic treatment is considered, but preliminary macroscopic algorithms have been investigated. (auth)

24643 (NP-20763) NUCLEAR PHYSICS AND HYPERFINE INTERACTIONS. Progress Report. (Uppsala Univ. (Sweden). Fysiska Institutionen). 1974. 64p. Dep. NTIS (US Sales Only) $4.50.

The following is a short presentation of research carried out by staff belonging to the Institute of Physics, Uppsala University, wholly or partially under the auspices of AFR (Statens Rad för Atomforskning) during 1974 in nuclear physics and hyperfine interactions maintained by research groups at this institute. The main part of the work performed in nuclear physics is carried out at the Tandem Laboratory. Essentially all nuclear spectroscopy in this year's report has been done by "in beam" methods. Specialized equipment placed at the accelerator have also produced data on nuclear magnetic moments and quadrupole moments. Work on nuclear properties by the use of radioactive sources is still performed in some specialized instruments, particularly on nuclear moments. These studies are often made as complementary additions to those carried out at the accelerator and serve in some cases as necessary calibrations of results obtained in reaction work. The continued use of radioactive sources – mainly produced in the synchrocyclotron of the Gustaf Werner Institute – is important for some of the studies of hyperfine interactions. Hyperfine interactions are studied to obtain information on magnetic and electric properties of various solid systems, where the nuclear spectroscopic methods (PAC and Mössbauer) are shown to give unique information on e.g. magnetic coupling mechanisms and relaxation. Hyperfine interactions for nuclei recoiling after certain reactions can provide information on properties of highly ionized atoms stopping in various materials. The mass separator has been useful for the preparation of "exotic" targets and implantation of atoms for hyperfine interaction studies. (auth)

24644 (ORO-1067-14) ANNUAL REPORT [ON NUCLEAR PHYSICS]. (Triangle Universities Nuclear Lab., Durham, N. C. (USA)). 31 Dec 1975. 144p. (TUNL-14). Dep. NTIS $6.00.

A summary is given of work completed and continued during 1975 in the areas of neutron and fission physics, charged-particle reactions, and theory. (SDF)

24645 (PEL-202) PELINSCA: A PROGRAM FOR NUCLEAR ELASTIC AND INELASTIC SCATTERING CALCULATIONS. Engelbrecht, C. A.; Fiedeldey, H.; Tepel, J. W. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Oct 1974. 78p. Dep. NTIS (US Sales Only) $5.00.

This report contains the theoretical background and program description of a computer code for optical and statistical model calculations of nuclear reactions. The optical model part calculates total and differential shape elastic cross sections and polarizations nonrelativistically at nucleon energies up to at least several hundreds of MeV, with correspondingly lower energies in the case of heavy ion reactions. The statistical model part also allows reactions with different incoming and outgoing particles. The angular distributions of subsequent decay gamma rays of the product nucleus are also calculated. In addition to the usual Hauser-Feshbach theory, the code also allows for the inclusion

of unitary elastic enhancement, part of which accounts for the width fluctuation corrections to Hauser-Feshbach theory. (auth)

24646 DIRECTED ATOMIC COLLISIONS IN SINGLE CRYSTALS AS A METHOD OF MEASURING THE LIFETIMES OF SHORT-LIVED NUCLEI AND OF CRYSTAL-LATTICE INVESTIGATION. Fiks, V.B. (A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences). JETP Lett. 22: No. 3, 85-86 (5 Aug

A method is proposed for measuring the lifetimes of short-lived nuclei ($\tau \sim 10^{-16}$–10^{-14} sec) and for the use of such nuclei as indicators. The method is based on controlled collisions of unstable nuclei (atoms) with the nearest neighbors in a single-crystal lattice. (auth)

Neutron Interactions with Matter

Refer also to abstracts 24997 and 24999.

24647 (KFK-2219) MEASUREMENT AND CALCULATION OF NEUTRON LEAKAGE SPECTRA FROM IRON SPHERES WITH A ^{252}Cf SOURCE IN THE CENTER. Werle, H.; Bluhm, H.; Fieg, G.; Kappler, F.; Kuhn, D.; Lalovic, M. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1975. 68p. (In German). Dep. NTIS (US Sales Only) $4.50.

The neutron leakage spectra from six iron spheres (diameter 15, 20, 25, 30, 35 and 40 cm) with a ^{252}Cf source in the center were measured with proton recoil proportional counters and ^{3}He-semiconductor-spectrometers in the energy range 0.06 to 8 MeV. The calculations have been performed using the S_N-multigroup neutron transport program DTK and data based on KEDAK. Generally there is a very good agreement between the calculated and measured spectra. From a detailed analysis of the small discrepancies in the energy region above 0.9 MeV some minor changes in the inelastic scattering cross-section are suggested. 32 figures, 8 tables (auth)

24648 (KFK-2231) SCATTERING LAW OF POLYCRYSTALLINE AND LIQUID RUBIDIUM. Suck, J. B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Dec 1975. 89p. (In German). Dep. NTIS (US Sales Only) $5.00.

The scattering law of polycrystalline liquid rubidium was measured for momentum transfers between 1.0 and 2.5 1/A and for energy transfers up to 16 MeV with a rotating crystal TOF-spectrometer. The energy of the incoming neutrons was 5 MeV. The polycrystal was measured at 123 and 294 K and the liquid at 318 K near its melting point. The data are corrected for background, selfabsorption, and multiple scattering. In the scattering law of the polycrystal at 123 K a peak structure is seen for energy transfers greater than 0, which is damped out in the results of the polycrystal at 294 K and the liquid. The measured scattering laws are compared with several scattering law models. Only the 123 K results give really satisfactory agreement. From the data of the polycrystals the density of states are extracted. For the liquid the 4. moment, some points of the 6. moment, and the relaxation function tau(Q) are determined. (auth)

24649 (LA-6219-MS) LINX AND BINX: CCCC UTILITY CODES FOR THE MINX MULTIGROUP PROCESSING CODE. MacFarlane, R. E.; Kidman, R. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 22p. Dep. NTIS $4.50.

The LINX and BINX codes were written to manipulate multigroup cross-section libraries in the CCCC format. The LINX code is used to merge two ISOTXS or BRKOXS libraries. The BINX code is used to convert any ISOTXS, BRKOXS, or DLAYXS library from binary to BCD mode or back with the option to list all or any part of the library. These codes are utilities for the MINX multigroup processing system. 2 tables (auth)

24650 (LA-tr-76-5) CROSS SECTIONS FOR CREATION OF DAMAGE. Lott, M.; Genthon, J. P.; Gervaise, F.; Mas, P.; Mougniot, J. C.; Van Doan, N. 1976. Translated from pp 89-126 of Symposium on Applications of Nuclear Data in Science and Technology, Paris, France, March 12-16, 1973. 43p. Dep. NTIS $4.00.

Differential cross sections representing the rate of creation of damage are established; with these it is possible to calculate the simplest quantities associated with irradiation–i.e., the energy imparted to the material in the form of elastic collisions and the number of displacements per atom. The data necessary for calculating these damage functions are: (a) the neutron cross sections (elastic and inelastic) with their angular distributions; with these it is possible to calculate the spectrum of the (primary) recoil atoms associated with a neutron collision; (b) the energy given up and the number of atoms displaced by the primary atom, which are calculated by means of Lindhardt's universal curve, the results of which are compared with those of a collision-by-collision calculation of the displacement cone. The ARTUS and SOURCE codes are used in calculating with these data the energy imparted to the lattice and the number of displacements per atom. ARTUS X is linked with the UKNDF file. Results are given for all usual cases of common metals and steel. The cross sections necessary for calculating rates of creation of gas (H and He) in irradiated metals are reviewed. 10 tables, 10 figures. (auth)

24651 (ORNL/CSD-7) USERS GUIDE TO MORSE-SGC. Fraley, S. K. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. 53p. Dep. NTIS $4.50.

The MORSE-SGC (Super Grouped Cross Section) code is a version of the MORSE code which reduced the core size requirements to solve problems with large cross-section storage requirements. This version of the MORSE code is available with both an improved combinatorial geometry package and a KENO geometry package. Other changes were also implemented in the code to make problem formulation more convenient. 11 tables. (auth)

24652 (RT/FI-(75)7) HEFREM: MODULAR SYSTEM BASED ON HETEROGENEOUS CODES. Broccoli, U. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Apr 1975. 102p. Dep. NTIS (US Sales Only) $5.50.

HEFREM is a modular system based on the heterogeneous codes HETROIS and SOS devised for interpretation of progressive substitution experiments or for valuation of nonmultiplying elements. (auth)

24653 THEORY OF TIME-DEPENDENT THERMAL NEUTRON TRANSPORT IN A MODERATOR CONTAINING A LARGE SPHERICAL CAVITY. Ilieva, K. D.; Kazarnovskii, M. V. At. Energ. (USSR); 39: No. 3, 186-190(Sep 1975). (In Russian)

The transport of thermal neutrons from a pulsed source in the block of a weakly absorbing moderator containing a large spherical cavity is considered for an arbitrary ratio of cavity radius to diffusion length. A comparison of the obtained results with experimental data for water poisoned by boron shows that such experiments can be used as a new method to measure albedo, lifetime and diffusion coefficient. (1 table, 6 references) (auth)

24654 PRODUCTION OF INTENSE BEAMS OF COLD NEUTRONS. Tewari, S. P.; Gangwani, G. S.; Kothari, L. S. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Nucl. Instrum. Methods; 128: No. 3, 583-584(15 Oct 1975).

Theoretical steady state neutron spectra study on various H_2O-D_2O mixtures of sample size approximately 0.082 m^3 placed at 21 K in a 1/E spectrum shows that the mixture containing 20% H_2O and 80% D_2O is the optimum for the production of intense beams of cold neutrons. (NL)

24655 SAMPLE-SIZE EFFECTS IN NEUTRON SCATTERING STUDIED WITH ANALYTIC AND MONTE CARLO METHODS. Velkley, D. E.; Brandenberger, J. D.; Glasgow, D. W.; McEllistrem, M. T. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA)). Nucl. Instrum. Methods; 129: No. 1, 231-239(1 Nov 1975).

The accuracy of approximate, analytic methods for correcting neutron scattering data for sample-size effects is studied in detail by comparison with Monte Carlo calculations carried out with good statistics. Conditions for good agreement between the two methods are obtained. The effects of the finite extent of the neutron source and of the flux anisotropy from the source reaction are also examined; a method is given for minimizing anisotropy effects when normalizing measurements to those with a polyethylene scatterer. (NL)

24656 SPECTRA OF RESONANCE NEUTRONS IN MEDIA CONTAINING ^{23}Na. Platonov, A. P. Sov. At. Energy (Engl. Translated from At. Energ. (USSR); 38: No. 2, 101-103(Feb 1975).

two-component homogeneous infinite media, determined on the basis of a numerical solution of the equation of moderation in the neighborhood of the 2.85 keV level of ^{23}Na for the equivalent systems Na–H, Na–O, Na–Fe, Na–Zr, and Na–Pb. (The scattering cross section of the nonresonance component for one ^{23}Na nucleus is the same for all the systems.) For the systems Na–H, Na–Fe, and Na–O, the scattering cross section of the non-resonance component varied over a wide range of values from 1 to 1000 b. (auth)

24657 NATURAL COORDINATE SYSTEM FOR THE TRANSPORT EQUATION IN CYLINDRICAL GEOMETRY. Smelov, V. V.; Shmurygin, P. A. Sov. At. Energy (Engl. Transl.); 38: No. 2, 135-136(Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 104-105(Feb 1975).

In order to make the transport equation in problems requiring cylindrical symmetry transform into a one-dimensional equation

as ρ goes to infinity (as in the spherical case), it is proposed that θ be measured in a cylindrical coordinate system from the normal to the coordinate system ρ = constant, and the azimuthal angle ψ from the z axis. (SDF)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 24398, 24417, and 24707.

24658 (AEEW-M-1368) REVISION OF PHOTON INTERACTION DATA IN THE UKAEA NUCLEAR DATA LIBRARY. Knipe, A. D. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Oct 1975. 65p. Dep. NTIS (US Sales Only) $4.50.

Photon interaction data in the UKAEA Nuclear Data Library have been updated and extended to cover all elements up to Atomic Number 94. Cross sections for the photoelectric effect, Compton scattering, pair-production, and the total cross section, are stored at 40 energy points in the range 0.01 MeV to 20 MeV. The angular distribution for Compton scattering is also included in the library. This report describes the derivation and accuracy of the data, and tabulates the cross sections and angular distribution in the appendices. The preparation of multigroup cross sections from the library's data is also discussed. (auth)

24659 (LA-6186-MS) TABULATED p-^{4}He PHASE SHIFTS. Dodder, D. C.; Hale, G. M.; Jarmie, N.; Jett, J. H.; Keaton, P. W. Jr.; Nisley, R.; Witte, K. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-Eng-36. 11p. Dep. NTIS $4.50.

This table contains calculated phase shifts for p-^{4}He elastic scattering from 0 to 17 MeV at intervals suitable for linear interpolation. (auth)

24660 (UCRL-50400(Rev.1)(Vol.6)) TABLES AND GRAPHS OF PHOTON INTERACTION CROSS SECTIONS FROM 1.0 keV TO 100 MeV DERIVED FROM THE LLL EVALUATED NUCLEAR DATA LIBRARY. Plechaty, E. F.; Cullen, D. E.; Howerton, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. Contract W-7405-Eng-48. 505p. Dep. NTIS $13.60.

Energy-dependent evaluated photon interaction cross sections and related parameters are presented for the elements H through Cf (Z equals 1 to 98). Data are given over the energy range from 1 keV to 100 MeV. The related parameters include form factors and average energy deposits per collision (with and without fluorescence). Fluorescence information is given for all atomic shells that can emit a photon with a kinetic energy of 1 keV or more. In addition, the following macroscopic properties are given: total mean free path and energy deposit per centimeter. This information is derived from the Livermore Evaluated Nuclear Data Library (ENDL) as of Oct. 1975. (auth)

24661 CORRECTIONS TO THE IMPULSE APPROXIMATION FOR $\pi^-d \rightarrow nn\gamma$. Duck, I. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). Phys. Lett., B; 59: No. 1, 9-12(13 Oct 1975).

Corrections to the impulse approximation for $\pi^-d \rightarrow nn\gamma$ are calculated. The results substantiate the conclusions of McVoy and of Bander, that the energy dependence of the amplitude is determined precisely by the neutron-neutron $^1S_0$ final state interaction. Corrections to the normalized spectrum are less than 2% up to nn energies greater than 1 MeV. (NL)

24662 MEASUREMENTS OF RELATIVE NEUTRON ANGULAR YIELD FROM T(p,n) AND D(p,n) REACTIONS AT 9.5 MeV PROTON ENERGY. Mostafa, A. B. M. G. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Instrum. Methods; 129: No. 1, 251-255(1 Nov 1975).

Measurements of relative angular yield from T(p,n)^{3}He and D(p,n)2p reactions are reported. The neutrons were produced from a high current gas target by the bombardment of 9.5 MeV protons. The yield measurements were made by a modified "long counter" between 15° and 135° at 15° intervals. Corrections were applied to the data for the detection efficiency of the long counter at different neutron energies. Normalized cross sections are also reported. The problems regarding background neutron production from a high current gas target are discussed. (NL)

24663 UNASSOCIATED PARTICLE METHOD FOR PRODUCING A STANDARD NEUTRON FLUX FROM THE D-D REACTION. Ryves, T. B.; Sharma, D. (National Physical Lab., Teddington (UK)). Nucl. Instrum. Methods; 128: No. 3, 455-459(15 Oct 1975).

In the associated particle method for producing a standard monoenergetic neutron flux from the D(d,n)^{3}He reaction, the neutron flux is deduced from the associated ^{3}He flux, but a number of difficulties arise when using solid targets, especially those caused by the slowing down of the deuteron beam in the target. A method is described for the establishment of a standard neutron flux measuring the uncorrelated proton flux from the competing D(d,p)T reaction. It is shown that, for a neutron angle of about 92° and a proton angle of about 108°, the ratio of neutrons to protons is constant to within 1% for all deuteron energies between 0 and 140 keV. This implies that the standard neutron flux so defined is almost independent of the properties of the solid target being used. (NL)

24664 SUM RULES FOR d(γ,n)p REACTION. Shyam, R.; Mukherjee, S. N. (Banaras Hindu Univ., Varanasi, India). pp 63-65 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Levinger-Bethe sum rules for γ(d,n)p reaction have been evaluated for realistic nucleon-nucleon forces with soft core. The bremsstrahlung weighted and integrated cross sections have been evaluated and the results are compared with experiments and those obtained employing Yale and Hamada-Johnston potentials with hard core. It is seen that the results are insensitive to the nature of the core. (auth)

24665 (π^+,p) AND (p,π^+) REACTIONS IN LIGHT NUCLEI. Bhalerao, R. S.; Waghmare, Y. R. (Indian Inst. of Tech., Kanpur). pp 168-171 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Cross sections for the related reactions (π^+,p) and (p,π^+) are calculated using the self-consistent reaction matrix theory. The Hartree-Fock wave functions were calculated using a realistic nucleon-nucleon interaction and they take into account the short-range correlations between the nucleons in the initial and final state of the nucleus. Pion and proton wave functions are represented by plane waves. Nuclei studied are ^{6}Li, ^{9}Be, ^{12}C and ^{16}O. Cross sections for reactions leading to the ground- and excited states of the residual nucleus are calculated separately. The effect of the final state nucleon-nucleus scattering is estimated. Variation of the cross section with the oscillator well parameter is studied. Results are compared with the available experimental data and the predictions of various other theories, and they are found to be satisfactory. (auth)

24666 CLUSTER MODEL STUDY OF THE 26.4-MeV ($J^\pi = 2^-$, T = 1) STATE IN ^{4}He. Jain, V. K.; Srivastava, B. B. (Meerut Univ., India). pp 172-174 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

There is evidence for the existence of a number of broad and strongly overlapping excited states in ^{4}He in the energy region just above the d + d threshold. Of these states, however, only the $J^\pi = 2^-$, T = 1 excited state at about 26 MeV excitation is reasonably well established. In the analysis of the elastic scattering of deuterons from deuterons Thompson finds evidence of a resonance in the ^{3}P phase shifts near the d + d threshold. Hence, variational method has been used to calculate the energy of the $J^\pi = 2^-$, T = 1 state by assuming for it a properly antisymmetrized trial wave function corresponding to a deuteron-deuteron cluster structure. A two-nucleon interaction producing good fit to the low energy nucleon-nucleon scattering data was used. This calculation gives a value of 25.2 MeV for the excitation energy which is in fair agreement with the experimental value of 26.4 MeV. (auth)

24667 ENERGY LEVELS OF ^{10}B. Narayana, K. L. (Shivaji Univ., Kolhapur, India); Patil, C. I. pp 175 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The energy levels of ^{10}B have been calculated adopting Berggren's nuclear overlap integral formalism and assuming the dual core model. For the outermost two nucleons previously used non-orthogonal set of wave functions, but now including the isospin, are adopted. The model has the advantage that the convergence criteria of wavefunctions surmounts the incompleteness of the chosen wave functions. The quantum numbers p and q representing the lowest orbitals couple to give rise the orbital angular momentum L. The evaluated (JT) energy levels are compared with the experimentally determined energy levels. The extensive

work on the CDC 3600 computer gave the best set of seven parameters values as - (0.55, 0.4, 2.5, 4.15, 2.88, 3.25, 1.125) each of which corresponds to a specific set of (JT) values. The linear combinations of the admixed configurations thus obtained are used to estimate the Quadrupole moment of ^{10}B nucleus. (auth)

24668 STRUCTURE OF ^{8}B WITH PROJECTED MULTI-MAJOR SHELL HARTREE–FOCK CALCULATIONS. Kamble, V. B.; Khadkikar, S. B.; Kulkarni, D. R. (Physical Research Lab., Ahmedabad, India). pp 204-205 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

Major shell-mixing calculations are carried out in the configuration space of first four major shells within the framework of Hartree-Fock (H-F) theory for the ^{8}B nucleus incorporating centre of mass motion and Coulomb corrections. Axial symmetry is assumed. The interaction used is the realistic interaction obtained by the Sussex group directly from the experimental phase-shifts. Good angular momentum states have been projected from the H-F solution to explain some of the properties of this nucleus, viz. the energy levels, magnetic dipole moment and the electric quadrupole moment. Preliminary band-mixing calculations for the bands k = 1 and k = 2 are also carried out. Energy levels and the magnetic dipole moment are compared with the experimental data and the agreement is found to be fair. The electric quadrupole moment has been theoretically predicted. The results are also compared with other theoretical calculations. (auth)

24669 STUDY OF THE FIRST EXCITED STATE IN ^{5}Li. Gagne, R. M.; Fou, C. M.; Ward, S. (Delaware Univ., Newark (USA). Dept. of Physics). J. Phys. (Paris); 36: No. 9, 759-763 (Sep 1975).

The reaction ^{6}Li(^{3}He,α)^{5}Li(α)p was studied with a 1.8 MeV incident ^{3}He beam. Coincidence spectra (α–α) were measured at θ_1 = 25 deg, 35 deg, 40 deg and θ_2 = –150 deg. The purpose was to locate the first excited state of ^{5}Li. The analysis yields E(x) = 3.2 + 0.2 MeV and Γ = 1.5 ± 0.5 MeV t. (FR)

24670 PION CHARGE EXCHANGE ON ^{3}H. Hess, A.T.; Gibson, B.F. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). Phys. Rev. C 13: No. 2, 749-753 (Feb 1976).

We have examined the reaction ^{3}H(π^+,π^0)^{3}He using separable pion-nucleon t matrices in a formalism which incorporates multiple scattering to all orders. Spin-flip effects are shown to be important. The total cross section has a maximum of about 7 mb in the neighborhood of the (3,3) resonance. (auth)

24671 QUASIELASTIC ELECTRON SCATTERING FROM ^{3}He AND ^{4}He. McCarthy, J.S. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901); Sick, I.; Whitney, R.R.; Yearian, M.R. Phys. Rev. C 13: No. 2, 712-714 (Feb 1976).

Experimental quasielastic electron scattering results for ^{3}He and ^{4}He are given for 500 MeV incident electrons and a laboratory scattering angle of 60°. The dynamics of the ^{3}He and ^{4}He nuclei are discussed in light of the results. (auth)

24672 EXTRACTION OF RESONANCE PARAMETERS FROM NUCLEAR SCATTERING DATA. Ahmed, M.U.; Shanley, P.E. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. Lett. 36: No. 1, 25-27 (5 Jan 1976).

A procedure is described for extracting the pole position of a resonant amplitude from a knowledge of the phase shift versus energy. Pole positions are determined for the four p-wave resonances in the nucleon-α system with high precision. The use of the pole position to define the mass of unstable nuclear states is discussed. (auth)

24673 TOTAL REACTION CROSS SECTION FOR PROTONS ON ^{3}He AND ^{4}He BETWEEN 18 AND 48 MeV. Sourkes, A.M.; Houdayer, A.; van Oers, W.T.H. (Department of Physics, University of Manitoba, Cyclotron Laboratory, Winnipeg, Manitoba, Canada R3T 2N2); Carlson, R.F.; Brown, R.E. Phys. Rev. C 13: No. 2, 451-460 (Feb 1976).

An attenuation technique has been used to measure the total reaction cross section σ_R for the systems p+^{3}He and p+^{4}He at 10 and 16 incident proton energies, respectively, between 18 and 48 MeV. The attenuations were measured to about 2% and the elastic corrections are known to about 2%. This results in the σ_R values being determined to about 8%, with smaller errors than this at the high energies and larger errors than this at the low energies. The data are compared with results from elastic scattering analyses using phase shifts, the optical model, and the resonating-group method. (auth)

24674 THREE-BODY PHOTODISINTEGRATION OF ^{3}He. Gibson, B.F. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545); Lehman, D.R. Phys. Rev. C 13: No. 2, 477-488 (Feb 1976).

Cross sections for three-body photodisintegration of ^{3}He are calculated in the electric dipole approximation. The calculation is performed within the context of exact three-body theory with the two-nucleon interactions represented by s-wave, spin-dependent separable potentials fitted to low-energy nucleon-nucleon scattering data. The photodisintegration amplitude is expressed in terms of the fully off-shell nucleon-plus-correlated-pair amplitudes, a method applicable to any weak-process disintegration amplitude. The numerical results indicate: (1) The ^{3}He(γ,n)2p total cross section has a peak value of approximately 1 mb. (2) The neutron spectra for ^{3}He(γ,n)2p and the proton spectra for ^{3}He(γ,p) np peak sharply in the region of the strong p-p final state interaction. (auth)

24675 SPECTATOR MOMENTUM DISTRIBUTION IN D (x, xp) n REACTIONS. Ksenzov, V.F. (Institute of Theoretical and Experimental Physics). JETP Lett. 22: No. 3, 80-81 (5 Aug 1975).

The causes of the qualitative differences in the form of the neutron momentum distributions in reactions of the D (x, xp) n type are explained within the framework of the mechanism of quasielastic knock-out followed by np rescattering. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 23387, 24591, 24658, 24660, 24685, 24687, 24738, 24743, 24744, 24764, 24771, and 24944.

24676 (ISN-75-17) EXPERIMENTAL STUDY OF GIANT DIPOLE AND QUADRUPOLE RESONANCES IN ^{16}O. Buenerd, M.; Martin, P.; de Saintignon, P.; Loiseaux, J. M. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1975. 11p. Dep. NTIS (US Sales Only) $3.50.

The 20-30 MeV excitation energy region of ^{16}O was investigated by inelastic scattering of 45 MeV protons and 60 MeV alpha-particles. E1 and E2 strengths were located. 3 figures. (auth)

24677 (ORO-4856-28) PION PRODUCTION IN ^{3}He COLLISIONS ON COMPLEX NUCLEI: A COMPARISON OF THEORY WITH EXPERIMENT. Fulcher, L. P.; Banerjee, M. K. (Bowling Green State Univ., Ohio (USA); Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1976. 33p. Dep. NTIS $4.00.

The BLSZ theory of inclusive pion production is applied to the (p,π^+) and the (^{3}He,π^0) reactions on ^{12}C. The calculations are based on plane waves for the projectile and pion wave functions and are compared with experiments. The effects of distortion are considered. The magnitudes of the (p,π^+) reaction cross sections are comparable to the experimental values, but for the (^{3}He,π^0) case the theoretical results are four or five orders of magnitude larger than the experiments. (auth)

24678 PROJECTED HARTREE-FOCK CALCULATION AND INTERMEDIATE COUPLING FOR ^{12}C. Bouten, M. C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Bouten, M. (Limburgs Universitair Centrum (Belgium)). J. Phys. (Paris); 36: No. 9, 765-767(Sep 1975). (In French)

An intermediate coupling calculation has been carried out for ^{12}C using the deformed functions obtained from a projected Hartree-Fock calculation as a basis. It is found that deformation and intermediate coupling are both necessary for obtaining good energies and transition probabilities in the ground-state band. (FR)

24679 LIFETIMES FOR SOME LEVELS IN ^{19}F. Lebrun, C.; Guilbaut, F.; Avignon, P. (Nantes Univ., 44 (France)); Deschamps, Y. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). J. Phys. (Paris), Lett.; 36: No. 9, L.201-L.203(Sep 1975). (In French)

Excitation energies and mean lifetimes were measured for nine ^{19}F levels up to 6 MeV, excited in the ^{18}O(d,nγ)^{19}F reaction. From these lifetimes, which were deduced from Doppler shift measurements, M1 strengths have been deduced and compared with shell model predictions. (FR)

24680 ASYMMETRY AND POLARIZATION OF THE RECOIL NUCLEUS IN MUON CAPTURE. Devanathan, V.; Subramanian, P. R. (Univ. of Madras). pp 122-125 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

Expressions for the resultant polarizations of ^{12}B nuclei recoiling in the experimental arrangement of Louvain-Saclay Collaboration are derived. How these polarizations are related to the

average polarization P_N, the longitudinal polarization P_L and the asymmetry parameter α is investigated. The experiment consists of two parts. In the first (second) part, the polarization of the nuclei recoiling into the forward (backward) hemisphere is preserved whereas it is destroyed in the backward (forward) hemisphere. Of the three quantities α, P_N and P_L only P_N and P_L can be found directly. It is proved that $\alpha - 2P_L = 1$ and this relation is independent of nuclear models and coupling constants of the muon capture interaction. Using this relation, α can be found. It is found that α, P_N and P_L are sensitive to the g_P/g_A ratio but insensitive to the nuclear model used. (auth)

24681 CASCADE PROCESS IN MUON CAPTURE: GAMMA-NEUTRINO ANGULAR CORRELATIONS. Devanathan, V.; Subramanian, P. R. (Univ. of Madras). pp 126 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

A nuclear cascade process resulting from muon capture and subsequent de-excitation by gamma emission is considered. The gamma ray yield is expressed in terms of certain observable correlations involving the three vectors - the gamma ray momentum, the neutrino momentum, and the muon polarization. We have investigated the process $^{16}O(0^+, g.s.) \xrightarrow{\mu^-} {}^{16}N(1^-, 392\ keV) \xrightarrow{\gamma} {}^{16}N$ (0^-, 120 keV). The angular correlation coefficients are independent of g_P/g_A but sensitive to g_A/g_V and nuclear structure. We have used the single particle j - j coupling shell-model and the Gillet and Vinh Mau wave functions. Simple relations independent of nuclear models and coupling constants of the muon capture interaction are obtained between nuclear recoil asymmetry α and the angular correlation coefficients. Measurements of correlation coefficients, therefore, give one a handle to find α and hence present an alternative to other efforts in the field. (auth)

24682 $^{19}F(\alpha,n)^{22}Na$ REACTION IN THE ENERGY RANGE 2.6 TO 5.1 MeV. Balskrishnan, M.; Kailas, S.; Karekatte, S. S.; Mahta, M. K. (Bhabha Atomic Research Center, Bombay). pp 127-129 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Absolute total cross section for the reaction $^{19}F(\alpha,n)\ ^{22}Na$ has been determined for the incident alpha energy range E_α= 2.6 to 5.1 MeV using thin target (~6 keV for 2 MeV alphas) and in fine steps of 5 keV. The excitation function shows some isolated resonances and also some cluster of states in ^{23}Na in the energy of excitation 12.6 to 14.7 MeV. An average strength function is extracted for the alpha-widths in this energy range. The results are compared with existing similar data in this region, obtained from gamma ray information. (auth)

24683 IS $_{\Lambda}C^{12*}$ A STRANGENESS ANALOG STATE. Banerjee, S.; Panchapakesan, N. (Univ. of Delhi). pp 182-184 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Strangeness analogue states are coherent superposition of particle-hole states where the particle and neutron hole occupy identical orbits. We discuss the possibility of $_{\Lambda}C^{12*}$ state being a strangeness analogue state in the framework of alpha particle model. We first discuss C^{12} in this model using equilateral triangle configuration. This is done with three different N-N potentials; those of Volkov, Gillet and Brink-Boeker. The radius and separation of the alpha clusters are determined knowing the binding energy of C^{12}. The same wavefunction is taken to describe $_{\Lambda}C^{12*}$ in which one cluster has a Λ-particle in it instead of a nucleon. With this wavefunction the Λ-N potential which gives the observed binding energy is calculated. This Λ-N potential is expressed in terms of an equivalent soft potential which has a volume integral about 30% to 50% more than that obtained from the study of light hypernuclei. The idea of strangeness analogue state is thus seen to be consistent with the alpha particle model. (auth)

24684 COULOMB EFFECTS IN A = 12 MIRROR BETA DECAYS AND THE SECOND CLASS CURRENT PROBLEM. Khan, A. M. (Univ. of Decca, Bangladesh). pp 190-192 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The effect of the Coulomb potential on the proportional difference, δ, in mirror ft value has been calculated in order to study the possible existence of second class currents in the fundamental weak interaction. From theoretical considerations one could attribute this mirror asymmetry to three main factors, namely contributions of second forbidden and electromagnetic corrections to allowed ft values; contributions due to failure of exact isospin symmetry in the mirror nuclei involved; contributions due to the possible existence of a second class current (SCC) in the weak interaction. In the 1p shell decays the Coulomb contribution is found to be of the order of 5% or less, the mean observed δ for these decays being of the order of 15%. The analysis of the experimental data on mirror beta decays, after correcting for the Coulomb contribution, then suggests an energy dependent as well as an energy independent contribution to δ. The effects could possibly be ascribed to a non-conserved SCC. (auth)

24685 GIANT RESONANCES STUDIED IN CONTINUUM-RPA AND IN GCM-APPROACH. Krewald, S.; Faessler, A.; Speth, J.; Galonska, J. E. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Kernphysik); Birkholz, J. (Technische Univ. Darmstadt (F. R. Germany). Fachgebiet Theoretische Kernphysik). pp 267-268 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Giant resonances in ^{16}O, ^{40}Ca and ^{208}Pb have been calculated by using a RPA-wavefunction which takes into account the evaporation of a particle into the continuum. The widths of the resonances can therefore be obtained directly from the cross section plots. A density dependent delta-interaction with parameters fitted in the lead region to electromagnetic properties was used. (NL)

24686 RPA CALCULATIONS WITH THE SKYRME INTERACTION SIV. Blaizot, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). pp 263-264 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Most of the Skyrme interactions proposed by the Orsay group lead to imaginary eigenvalues in RPA calculations, mainly due to the too strongly attractive character of the force in the S = 1 T = 0 particle hole channel. The force SIV has a small S = 1 part and does not lead to imaginary eigenvalues; furthermore it gives good single particle energies in light nuclei and one should expect a RPA calculation to give reasonable results for these nuclei. Some results of such a calculation in ^{12}C, ^{16}O and ^{40}Ca are presented. The single particle energies and wave functions are those of the Hartree-Fock solution found with the same interaction. The continuum spectrum is discretized by diagonalizing the Hartree-Fock Hamiltonian in a large oscillator basis (7 major shells for the results presented). All the particle-hole configurations which can be constructed for a given multipolarity are taken into account; this method has been found to converge when the dimension of the basis is increased. (NL)

24687 BHF-PLUS-REARRANGEMENT CALCULATIONS WITH SOFT-CORE FORCES IN ^{16}O. Padjen, R.; Rouben, B. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire); Gogny, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)); Pires, P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). pp 151-152 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Both the third-order and second-order rearrangements are included in a self-consistent calculation of the single-particle (sp) field of ^{16}O, carried out with model G-matrices derived from two soft-core potentials: de Tourreil-Sprung (1973) and Pires-Gogny-de Tourreil (1973). (NL)

24688 PERTURBATION THEORY WITH A SOFT CORE TWO NUCLEON INTERACTION. Gogny, D.; Maire, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). pp 149-150 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The realistic soft core two nucleon interaction proposed by Gogny, Pires and de Tourreil (1970) is such that it is not necessary to have recourse to Brueckner theory in treating n-body problems. Therefore ordinary perturbation theory has been used to calculate the equilibrium properties (i.e., binding energy, density, radius and separation energy) of ^{16}O, ^{40}Ca, ^{90}Zr and ^{208}Pb. (NL)

24689 ONE-NEUTRON AND TWO-NEUTRON TRANSFER IN THE SCATTERING OF ^{16}O BY ^{16}O. Reisdorf, W. N.; Lau, P. H.; Vandenbosch, R. (Washington Univ., Seattle (USA)). Nucl. Phys., A; 253: No. 2, 490-510(24 Nov 1975).

Angular distributions have been measured for one- and two-neutron transfer reactions induced by ^{18}O beams on ^{16}O targets at lab bombarding energies of 42 and 52 MeV. The reactions populating the ground and first excited states of ^{17}O and ^{18}O are analyzed in terms of single-step finite range plus recoil DWBA theory taking into account antisymmetrization effects. Special attention is paid to an internally consistent description of the observed absolute magnitudes of all the reactions and to the theoretically expected interferences between various backward-forward scattering mechanisms. The importance of neutron transfer in accounting for different absorbing properties of the $^{16}O-^{18}O$ system as compared to the $^{16}O-^{16}O$ system is shown. (NL)

24690 MAGNETIC ELASTIC ELECTRON SCATTERING FROM ^{9}Be AND ^{13}C. Lapikas, L.; Box, G.; De Vries, H. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Nucl. Phys., A; 253: No. 2, 324-354(24 Nov 1975).

Elastic scattering through 180° from ^{9}Be, ^{12}C and ^{13}C targets has been observed for electrons of 35 to 90 MeV. Magnetic scattering cross sections for ^{9}Be and ^{13}C have been obtained by subtracting charge scattering as deduced from the spin-zero nucleus ^{12}C. Theoretical shell model predictions for the magnetic cross sections are derived for $(1s)^4(1p)^{A-4}$ configurations and various coupling schemes. Both harmonic oscillator and Woods-Saxon radial wave functions are used. A comparison of the results with magnetic rms radii $[\langle r^2\rangle_M]^{1/2} = 3.2 \pm 0.3$ fm and $[\langle r^2\rangle_m]^{1/2} = 3.3 \pm 0.3$ fm for ^{9}Be and ^{13}C. For ^{13}C a combined fit to low-q data and to earlier high-q data yields $[\langle r^2\rangle_M]^{1/2} = 3.4 \pm 0.1$ fm and a strong preference for intermediate coupling (IC) wave functions. Magnetic dipole scattering from ^{9}Be is also close to the IC prediction, as deduced from a fit to the data and earlier high-q data. The fitted value of the octupole moment $\Omega = 5 \pm 1$ $\mu_N fm^2$ can only be explained by a deformation of the average nuclear potential. The radial size $[\langle r^2\rangle_{1p}]^{1/2} = 2.85 \pm 0.05$ fm for the 1p radial wave function is in agreement with both the ^{9}Be and ^{13}C data. (NL)

24691 DECREASE OF GROUND-STATE CORRELATIONS FROM ^{12}C TO ^{14}C. Mairle, G.; Wagner, G. J. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 253: No. 2, 253-262(24 Nov 1975).

The (d,τ) reactions on ^{12}C, ^{13}C and ^{14}C have been investigated with 52 MeV deuterons. Spectroscopic factors have been extracted from a DWBA analysis of the measured angular distributions. The derived proton occupation numbers show that the addition of $1p_{1/2}$ neutrons leads to a consolidation of the $1p_{3/2}$ proton shell closure. The number of protons in the $1p_{1/2}$ shell of the target wave function decreases from 0.7 in ^{12}C to about 0.4 in ^{13}C and 0.3 in ^{14}C. This decrease is understood as the result of (i) a blocking of proton scattering into the $1p_{1/2}$ shell due to the presence of $1p_{1/2}$ neutrons or (ii) a decreasing deformation with increasing neutron number. (NL)

24692 MICROSCOPIC CALCULATION OF COLLECTIVE VIBRATIONS WITHIN THE HARTREE-FOCK APPROXIMATION. Blaizot, J. P.; Grammaticos, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). pp 269-270 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1974).

A formula for collective energy is derived and applied to various modes in ^{16}O using the Skyrme interaction SIII and RPA wavefunctions built on Hartree-Fock solution. (NL)

24693 SELF CONSISTENT R. P. A. CALCULATION WITH THE FINITE RANGE AND DENSITY DEPENDENT INTERACTION "D 1". Blaizot, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique); Gogny, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). pp 265-266 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Preliminary results are presented of R. P. A. calculation on ^{16}O with the particle-hole interaction derived from the interaction D 1. The particle-hole interaction is defined as the second derivative of the effective interaction with respect to the density. The density dependent effective interaction of finite range "D 1" is phenomenological in the sense that its relation with realistic nucleon-nucleon interactions was left out. However to prevent unrealistic admixture of spin and isospin terms, each of its components was checked on nuclear matter saturation properties as calculated with more fundamental approaches. (NL)

24694 ELASTIC AND INELASTIC DEUTERON SCATTERING ON ^{12}C IN THE ENERGY RANGE FROM 60 TO 90 MeV. Aspelund, O.; Hrehuss, G.; Kiss, A.; Knoepfle, K. T.; Mayer-Boericke, C.; Rogge, M.; Schwinn, U.; Seres, Z.; Turek, P. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 253: No. 2, 263-273(24 Nov 1975).

Elastic and inelastic scattering of deuterons on ^{12}C has been investigated in the incident energy range between 60 and 90 MeV. Angular distributions between 10° and 80° (lab) have been measured for states up to approximately 15 MeV; at still higher excitation energies some prominent groups of levels show up in the spectra, including a very broad structure peaked at 27 MeV. The elastic and inelastic scattering angular distributions were analyzed in the framework of standard optical model and coupled-channel analysis, respectively. The quadrupole deformation parameter was found to be $\beta_2 = -0.48 \pm 0.02$, independent of incident energy. The angular distributions for the second 0^+ and first 3^- state were analyzed using a rotation-vibration coupling scheme. (NL)

24695 MOMENTUM DEPENDENCE OF POLARIZATION CHARGES IN ELECTRON EXCITATION OF NUCLEI IN THE OXYGEN REGION. Horsfjord, V. (Oslo Univ. (Norway). Fysisk Institutt). Nucl. Phys., A; 253: No. 1, 216-230(17 Nov 1975).

The polarization effects for monopole and quadrupole electron excitations of nuclei in the oxygen region have been considered. A phenomenological method has been used in order to extrapolate empirical values for the polarization charges, from the real photon limit, to higher momentum transfers. In most cases polarization charges are found that are nearly constant, for momentum transfers up to 2 or 3 fm^{-1}, thus providing a justification in the oxygen region for the assumption most frequently made when experiment and theory are compared. (NL)

24696 MEASUREMENT OF THE MAGNETIC MOMENT OF THE FIRST EXCITED STATE OF ^{15}C. Hass, M.; King, H. T.; Ventura, E. (Rutgers-the State Univ., New Brunswick, N. J. (USA). Dept. of Physics); Murnick, D. E. (Bell Labs., Murray Hill, N. J. (USA)). Phys. Lett., B; 59: No. 1, 32-34(13 Oct 1975).

The g-factor of the $\frac{5}{2}^+$ first excited state of ^{15}C has been measured in a time integral, external magnetic field, perturbed angular correlation experiment. A value of $g = -0.77 \pm 0.06$ was obtained. In addition, the energy of the state was accurately measured to be 739 ± 1 keV. (NL)

24697 IMPROVED PREDICTIONS OF NEUTRON DETECTION EFFICIENCY RESULTING FROM NEW MEASUREMENTS OF $^{12}C(n,p)$ AND $^{12}C(n,d)$ REACTIONS AT 56 MeV. McNaughton, M. W.; King, N. S. P.; Brady, F. P.; Ullmann, J. L. (California Univ., Davis (USA). Crocker Nuclear Lab.). Nucl. Instrum. Methods; 129: No. 1, 241-245(1 Nov 1975).

New data has been obtained for the $^{12}C(n,p)$ and $^{12}C(n,d)$ reactions at 56 MeV and used to obtain improved predictions of neutron detection efficiency for a plastic scintillator. Previously reported discrepancies between efficiency data and the predictions of Stanton's and Kurz's codes in the energy region 6 to 41 MeV are now largely resolved. The prime culprit, applying equally to Stanton's, Kurz's and the 05S codes, is the treatment of the $^{12}C(n,p)$ reactions. Alterations have also been made to the cross sections and to the scintillation light output function assumed by Stanton and Kurz. Following these changes, agreement between data and predictions for a 4.2 MeV threshold improved from the order of 10% to the order of 3%. (NL)

24698 $^{12}C + p \rightarrow {}^{13}N(T = \frac{3}{2})$ RESONANCE AT 14.23 MeV. Hinterberger, F.; Rossen, P. V.; Ehrlich, H. G.; Schueller, B.; Jahn, R.; Bisping, J.; Welp, G. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 253: No. 1, 125-144(17 Nov 1975).

The excitation functions of the elastic scattering $^{12}C(p,p)^{12}C$ and the reactions $^{12}C(p,p')^{12}C(4.44$ MeV) and $^{12}C(p,\alpha)^{9}B_{g.s.}$ have been measured at $\theta = 175°$ in the region of the first $T = \frac{3}{2}$ state in ^{13}N with high energy resolution. A straightforward resonance analysis of the elastic scattering data yields $\Gamma = 1.10 \pm 0.09$ keV, $\Gamma_p = 210 \pm 11$ eV and $\Gamma_p/\Gamma = 0.191 \pm 0.017$. The results are compared with shell-model predictions. The additionally measured angular distributions of the elastic scattering $^{12}C(p,p)^{12}C$ above and below the resonance are compared with optical model calculations. The combination of the present results for Γ_p and Γ_p/Γ with previous results for Γ_γ/Γ_p and $\Gamma_\gamma\Gamma_p/\Gamma$ yields $\Gamma_\gamma = 27.0 \pm 2.2$ eV as a new determination of the $^{13}N(T = \frac{3}{2}$, 15.07 MeV $\rightarrow T = \frac{1}{2}$,

0 MeV) γ-decay width. The comparison with the analogous γ-decay in ^{13}C is discussed with respect to the charge symmetry of corresponding $\Delta T = 1$ γ-transitions in mirror nuclei. (NL)

24699 LOW-LYING STATES OF ^{19}F, ^{21}Ne, AND ^{23}Na BY THE GENERATOR COORDINATE METHOD AND BY THE PROJECTED HARTREE–FOCK CALCULATIONS. Mankoc-Borstnik, N.; Brut, F.; Jang, S. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). pp 81-82 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Use is made of the model for an inert core of ^{16}O with the valence nucleons in 2s-1d shell. Axially symmetric intrinsic wave functions are assumed and alternatively Kuo and Preedom–Wildenthal (PW) effective interactions are employed. For the low-lying states, both the GCM and PHF methods give good results with respect to the complete diagonalisation. (NL)

24700 TRIAXIAL HARTREE–FOCK CALCULATIONS USING SKYRME'S EFFECTIVE INTERACTION. Grammaticos, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). pp 331-332 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The Skyrme interaction has been used with success for the description of deformed nuclei throughout the periodic table. The so far available calculations have been limited to axial deformations only. The existence of γ-soft nuclei, and the importance of this degree of freedom in dynamical calculations have motivated the development of a Hartree–Fock code for the investigation of triaxial shapes. Some calculations on light nuclei are presented using different parametrizations of the Skyrme interaction. (NL)

24701 PARTICLE-HOLE STATES IN LIGHT NUCLEI. Rosina, M.; Mihailovic, M. V. (Ljubljana Univ. (Yugoslavia). Fakultet za Naravoslovje in Tehnologijo). pp 37-38 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The two-body density matrix represents a compact way of storing the information of the ground state (static moments, form factors, etc.). In addition, it contains all information needed to calculate the particle-hole states. Some results for light nuclei calculated in small model spaces are presented: the nucleus ^{16}O assuming inert ^{12}C core and 4 valence nucleons in the $1p_{1/2}$, $1d_{5/2}$, $2s_{1/2}$ subshells; the nuclei ^{20}Ne, ^{24}Mg, and ^{28}Si assuming an inert ^{16}O core and 4, 8, 12 nucleons in the 1d2s shells. The Hermitian operator method was used. The purpose of the calculation was (i) to see which levels can be interpreted as particle-hole states; (ii) to study how sensitive the results are if an approximate two-body density matrix is used. (NL)

24702 COLLECTIVE MASSES FOR ANHARMONIC ISOSCALAR VIBRATIONS. Brink, D. M.; Engel, Y. M.; Goeke, K. (Oxford Univ. (UK). Dept. of Theoretical Physics); Krieger, S. J. (Oxford Univ. (UK). Nuclear Physics Lab.); Vautherin, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). pp 33-34 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A hydrodynamic like expression is obtained for the total kinetic energy. Assuming monopole vibration and some density and velocity dependent interactions of the Skyrme type, the compression modulus and excitation energies of the first excited 0^+ states in ^{16}O and ^{40}Ca are given. (NL)

24703 PROJECTED MULTISHELL HARTREE–FOCK CALCULATIONS AND STRUCTURE OF SOME A = 8 NUCLEI. Khadkikar, S. B.; Kamble, V. B.; Kulkarni, D. R. (Physical Research Lab., Ahmedabad (India)). pp 85-86 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

H–F calculations have been carried out for the nuclei ^{8}B, ^{8}Li and ^{8}Be in the configuration space of first four major shells. Since all the nucleons are treated on an equal footing, the core-polarization effects are automatically taken care of. The interaction used is the realistic one obtained by the Sussex group with no hard core including partial waves up to l = 4. The value of the harmonic oscillator parameter chosen is b = 1.5 fm. Corrections arising due to the centre-of-mass motion and the Coulomb repulsion between protons have been explicitly incorporated. Axial symmetry has been assumed. (NL)

24704 REACTION $^{6}Li(pol)(d,\alpha)\alpha$ WITH A NEW HIGHLY POLARIZED ^{6}Li TARGET. Wittchow, F.; Ulbricht, J.; Holm, U.; Stahl, K. D.; Ebinghaus, H. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Experimentalphysik). Phys. Lett., B; 59: No. 1, 29-31(13 Oct 1975).

A highly polarized ^{6}Li target with a new polarizing principle has been developed. A surface is used to store polarized lithium particles from an atomic beam source. The maximum target tensor polarization is $P_{zz} = 0.81 \pm 0.06$ and the thickness 3×10^{14} ions per cm^2. (NL)

24705 STRUCTURE OF ^{12}C WITH DENSITY INDEPENDENT SKYRME INTERACTION. Kamble, V. B.; Khadkikar, S. B. (Physical Research Lab., Ahmedabad (India)). Phys. Lett., B; 59: No. 1, 19-21(13 Oct 1975).

It is shown that the two-body spin-orbit part of the interaction is crucial in explaining the ^{12}C energy spectrum. Thus a spin saturated model like alpha-cluster model would be quite inadequate to explain the structure of ^{12}C nucleus. (NL)

24706 POLARIZATION IN THE $^{18}O(n,n)$ REACTION. Drigo, L.; Tornielli, G.; Zannoni, G. (Univ., Padua). Nuovo Cim.; 31A: No. 1, 1-16(1 Jan 1976).

The analyzing power for neutrons elastically scattered by oxygen was measured in the energy range 2.25 to 3.90 MeV at seven angles from 25 to 155°. The relative differential cross sections were also obtained at the energies 2.56 and 2.76 MeV. A phase shift analysis of polarization and cross section data was carried out. (auth)

24707 ELASTIC SCATTERING OF PROTONS BY ^{12}C AT LOW ENERGIES. Cuzzocrea, P.; Inglima, G.; Perillo, E.; Rosato, E.; Sandoli, M.; Spadaccini, G. (Univ., Naples). Nuovo Cim.; 31A: No. 1, 182-192(1 Jan 1976).

Differential cross sections for the elastic scattering of protons by ^{12}C were measured at energies between 1.5 and 4.0 MeV, in steps of 0.5 MeV, in order to search for a possible cluster structure in light nuclei. The experimental results were compared with the predictions of the optical model, which fit the general trend of the data. Some discrepancies at small angles were found. The presence of correlations between the cross sections of the $^{4}He(p,p)$ reaction and a suitable function of the elastic scattering cross sections for protons on ^{12}C was investigated. The results of this analysis seem to confirm that the structures in the experimental cross sections (not accounted for by the optical model) are correlated to the behavior of the $^{4}He(p,p)$ cross sections at the same energies. (auth)

24708 HYPERSPHERICAL FUNCTIONS AND QUANTUM-MECHANICAL THREE-BODY PROBLEM WITH APPLICATION TO CARBON 12. Letz, H. (Univ., Erlangen, Ger.). Nuovo Cim.; 30B: No. 2, 348-363(11 Dec 1975).

A system of three identical particles (bosons) interacting by a particular two-body force is discussed. Using the complete set of the hyperspherical functions (K-harmonics) one finds analytical expressions for eigenvalues and wave functions of the stationary states. The numerical evaluation gives a level sequence for a definite pair of potential parameters similar to that of the nucleus carbon 12. (auth)

24709 DEPOLARIZATION IN THE ELASTIC SCATTERING OF 17 MeV POLARIZED PROTONS FROM ^{9}Be. Baker, M. P. Seattle; Univ. of Washington (1975). 134p. University Microfilms Order No. 75-28,312.

The Wolfenstein depolarization parameter D(theta) was measured for the elastic scattering of 17-MeV protons from ^{9}Be at laboratory scattering angles between 70^0 and 120^0 in 10^0 steps with uncertainties ranging from 0.05 to 0.07. The reaction was initiated by polarized protons and the polarization of those protons elastically scattered by the ^{9}Be analyzed using a high-resolution, silicon polarimeter. Several of the measured values of D(theta) differed significantly from unity, indicating non-zero probability for proton spin-flip in the elastic scattering process. Theoretical estimates of the depolarization-parameter angular distribution have been made using a multipole expansion of the elastic-scattering amplitude in terms of the amount of angular momentum transferred to the target nucleus during the scattering process. Here the J equals 0, 1 and 2 contributions to the scattering amplitude have been explicitly treated for the scattering from ^{9}Be(I equals $^{3}/_{2}$). The J equals 0 terms are calculated using the standard, spherical optical-model. The J equals 1 and 2 terms can be calculated using DWBA. Both spherical and tensor forms are considered for the J equals 1 interaction. The spin-flip probabilities predicted

assuming reasonable strengths for the J equals 1 potentials are much smaller than those observed experimentally. The J equals 2 contribution to the spin-flip probability is calculated assuming a rotational model for ^{9}Be. Predictions of the J equals 2, elastic spin-flip probability are substantially larger than the predictions for the J equals 1 contribution and are in rough agreement with the present data. The results of recent coupled-channels calculations also support the conclusion that large elastic spin-flip probabilities can be produced by the J equals 2 term in the elastic scattering amplitude. (Diss. Abstr. Int., B)

24710 GAMMA NEUTRINO CORRELATION IN MUON CAPTURE IN ^{19}F. Hock, G. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen); Oziewicz, Z. (Wroclaw Univ. (Poland). Instytut Fyziki Teoretycznej). Acta Phys. Pol., Ser. B; 4: 43-48(1973).

The ratio of the two amplitudes describing completely each of the transitions $^{19}F(g.s., 1/2^+) \xrightarrow{\mu} {}^{19}O(1/2^+)_{1,2}$ is studied. For the three transitions $^{19}F(g.s., 1/2^+) \xrightarrow{\mu} {}^{19}O(1/2^+)_{1,2,3}$ the gamma-neutrino directional correlation and circular polarization of nuclear gamma rays are calculated. All calculations were performed in shell model intermediate coupling with configuration mixing. (auth)

24711 BETA DECAY OF ^{16}C AND ^{17}N. Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973); Wilkinson, D.H. Phys. Rev. C 13: No. 2, 835-846 (Feb 1976).

The delayed neutron emitters ^{16}C and ^{17}N have been studied with a ^{3}He neutron detector and γ radiations have been measured with a Ge(Li) detector. ^{16}C was formed in the reaction $^{14}C(^{18}O,^{16}O)^{16}C$ with 56-MeV ^{18}O ions, and also in the reaction $^{11}B(^7Li,2p)^{16}C$ with 40-MeV ^{7}Li ions. The thermalized neutrons following both reactions yield together a ^{16}C half-life of 0.747±0.008 sec with the well-known 4.17-sec ^{17}N activity as an accompaniment formed in the $^{14}C(^{18}O,^{17}N)^{15}N$ and $^{11}B(^7Li,p)^{17}N$ reactions. The neutron spectra in a bare ^{3}He detector contain ^{16}C lines of 0.79±0.03 MeV and 1.72±0.05 MeV with relative intensities $I_{0.79}/I_{1.72}=5.4\pm0.7$ in addition to ^{17}N peaks. The ^{16}C neutron groups are assigned to the β decay to the known 3.36- and 4.32-MeV 1^+ states of ^{16}N with branches of 84.4±1.7% and 15.6±1.7%, respectively. A search for γ rays associated with ^{16}C forbidden β decay to the 0^-, 3^-, and 1^- levels of ^{16}N at 0.121, 0.297, and 0.397 MeV, respectively, gave upper limits of 0.5%, 0.5%, and 0.7% for the respective branching ratios ($\log ft > 6.85$, > 6.83, and > 6.64, respectively). The logft values for β decay to the 3.36- and 4.32-MeV states, 3.551±0.012 and 3.83±0.05, respectively, compare with preliminary theoretical values of 6.49 and 3.94, respectively, due to Millener. Separate studies were made of ^{17}N decay, formed in the $^{15}N(t,p)^{17}N$ reaction at $E_t=3.0$ MeV. By using an empirical neutron efficiency function, established for the ^{3}He detector with the $^3H(p,n)^3He$ reaction, β-ray branches of ^{17}N to the ^{17}O neutron-emitting states at 4.55, 5.38, and 5.94 MeV were found to be 39.2±2.0%, 48.0±1.5%, and 7.9±0.3%, respectively, in disagreement with two previously reported measurements. γ-ray measurements on ^{17}N with a Ge(Li) detector yielded the following: ratio of β-ray branching intensities $B_{871}/B_{3055}=8.6\pm0.4$; $B_{3841}<7\times10^{-5}$ corresponding to logft >8.5 for this β-ray branch thereby more firmly fixing the ^{17}N spin as $J^\pi=1/2^-$; energy of ^{17}O second-excited state 3055.2±0.3 keV; and ground-state γ-ray branch, from the 3055.2-keV level $<1.5\%$. The mirror β decays of the $A=17$ system are discussed. An incidental result is a half-life of 178.3±0.4 msec for ^{9}Li formed in the t (^{7}Li,p)^{9}Li reaction with 20–40-MeV ^{7}Li ions. (auth)

24712 EXCITATION FUNCTIONS OF PION REACTIONS ON ^{14}N, ^{16}O, AND ^{19}F THROUGH THE (3,3) RESONANCE. Jacob, N.P. Jr.; Markowitz, S.S. (Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). Phys. Rev. C 13: No. 2, 754-766 (Feb 1976).

Cross sections for pion-induced reactions of the form $(\pi,\pi N)$ and more complex spallation reactions of the form (π,X) have been measured from 50–550 MeV on the target nuclei ^{14}N, ^{16}O, and ^{19}F using the secondary pion beams at the Lawrence Berkeley Laboratory 184-inch synchrocyclotron and the Clinton P. Anderson Meson Physics Facility. The dominance of the (3,3) free-particle resonance is seen in all excitation functions determined in this work. Relative to the $^{12}C(\pi^+,\pi N)^{11}C$ reactions, the $(\pi^+,\pi N)$ reactions on ^{14}N, ^{16}O, and ^{19}F have magnitudes of 0.2, 1, and 0.7, respectively. The cross section ratio $R=\sigma(\pi^-,\pi^-n)/\sigma(\pi^+,\pi N)=1.68\pm0.18$ for ^{14}N at 188±15 MeV, 1.68±0.05 for ^{16}O at 188±9 MeV, and 1.68±0.03 for ^{19}F at 178±2 MeV incident pion energy. The results from this work are compared to previous pion work, analogous proton-induced reactions, Monte Carlo intranuclear cascade-evaporation calculations, and to a semiclassical nucleon charge-exchange model which convincingly explains the $(\pi,\pi N)$ reaction mechanism in the (3,3) resonance region. (auth)

24713 DEUTERON-CARBON ELASTIC SCATTERING AT 650 MeV. Chadha, K.S.; Varma, V.S. (Department of Physics and Astrophysics, University of Delhi, Delhi-7, India). Phys. Rev. C 13: No. 2, 715-719 (Feb 1976).

The Glauber theory of nucleus-nucleus scattering is used to calculate the elastic differential cross section for the scattering of deuterons off carbon nuclei using two-particle scattering data as input. We obtain qualitatively better agreement with the experimental measurements of Dutton *et al.* than their calculations using proton-carbon optical potentials. (auth)

24714 EXPERIMENTAL SEARCH FOR CONDENSED NUCLEAR STATES. Frankel, S.; Frati, W. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Highland, V.; Van Dyck, O.; Werbeck, R. Phys. Rev. C 13: No. 2, 737-741 (Feb 1976).

We have studied and made use of backward (180°) elastic scattering of 600 and 800 MeV protons as the experimental tool to search for the presence of nuclear states of very high binding energy, suggested by Feenberg and Primakoff and by Lee and Wick. This method, tested on a variety of targets, found no evidence for condensed nuclei (of 100 mb cross section) at a level of 10^{-8} per target nucleus. (auth)

24715 ELASTIC SCATTERING OF LITHIUM BY ^{9}Be, ^{10}B, ^{12}C, ^{13}C, ^{16}O, AND ^{28}Si FROM 4 TO 63 MeV. Poling, J.E.; Norbeck, E.; Carlson, R.R. (Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242). Phys. Rev. C 13: No. 2, 648-660 (Feb 1976).

Elastic scattering angular distributions have been measured at energies between 4.0 and 13.0 MeV for ^{6}Li and ^{7}Li beams and targets of ^{10}B, ^{12}C, ^{13}C, ^{16}O, and ^{28}Si. Yield curves have been measured for energies from 3.0 to 13.0 MeV for ^{6}Li beams and targets of ^{9}Be, ^{12}C, ^{13}C, ^{16}O, and ^{28}Si, and for ^{7}Li and ^{12}C. The angular distributions, supplemented by published angular distributions, have been fitted with optical-model potentials. For ^{6}Li+^{12}C, angular distributions were available at energies from 4.5 to 63.0 MeV. Potentials which gave fits to the data across the entire available energy range were obtained for each elastic scattering reaction. The usual ambiguities were observed in the optical-model potentials. In certain cases the back angles were not well fitted by parameter sets which were useful for all energies. The quality of the fits did not seem to be limited by experimental errors, which were generally better than 10% for our data; compound nucleus effects are presumed to be the cause of rapid energy variations in the angular distributions. (auth)

24716 GAMMA DECAY OF THE 13.42-MeV STATE OF ^{15}N. Kuan, H.M. (Brookhaven National Laboratory, Upton, New York 11973); Shirk, D.G. Phys. Rev. C 13: No. 2, 883-886 (Feb 1976).

The γ decay of the 13.42-MeV state of ^{15}N, studied via the reaction $^{14}C(p,\gamma)^{15}N$ using Ge(Li) detectors, is found to be 100% to ^{15}N(g.s.) with $\Gamma_p\Gamma_{\gamma_0}/\Gamma=1.70\pm0.5$ eV, $\Gamma_{\gamma_0}=3.0\pm0.9$ eV, and a $M2/E1$ mixing ratio of 0.00±0.04. (auth)

24717 SIMPLE APPROXIMATION FOR MULTISTEP AMPLITUDES. Cotanch, S.R.; Vincent, C.M. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. Lett. 36: No. 1, 21-25 (5 Jan 1976).

A surface approximation to the multistep amplitude for direct reactions is presented. Within this approximation, the distorted-wave Born-approximation series is summed in closed form, and the result is tested by comparing with exact coupled-reaction-channels calculations for $^{17}O(p,d,p)^{17}O$ and $^{16}O(d,p,d)^{16}O$. The approximation gives a good representation of the exact results, especially for the $^{16}O(d,p,d)^{16}O$ process which is dominated by strong absorption of the deuteron. (auth)

24718 MEASUREMENTS OF THE (π^+,π^0) REACTION ON LIGHT ELEMENTS IN THE (3,3)—RESONANCE REGION. Shamai, Y.; Alster, J.; Ashery, D.; Cochavi, S.; Moinester, M.A.; Yavin, A.I. (Department of Physics and Astronomy, Tel-Aviv University, Ramat-Aviv, Israel); Arthur, E.D.; Drake, D.M. Phys. Rev. Lett. 36: No. 2, 82-85 (12 Jan 1976).

The cross sections for the reaction (π^+,π^0) on ^{7}Li, ^{10}B, and ^{12}C were measured over the energy range of 70 to 250 MeV by activation methods. The excitation functions were found to be flat with cross sections of about 2.5 mb for ^{7}Li, 0.4 mb for ^{10}B, and 1.0 mb for ^{12}C. (auth)

24719 PION CHARGE-EXCHANGE SCATTERING FROM LIGHT NUCLEI. Gibbs, W.R.; Gibson, B.F.; Hess, A.T.; Stephenson, G.J. Jr. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545); Kaufmann, W.B. Phys. Rev. Lett. 36: No. 2, 85-88 (12 Jan 1976).

The reactions $^7Li(\pi^+,\pi^0)^7Be$, $^{10}B(\pi^+,\pi^0)^{10}C$, and $^{13}C(\pi^+,\pi^0)^{13}N$ are examined using a full multiple-scattering formalism with a separable form assumed for the pion-nucleon t matrix. Spin-flip contributions are included. We find that the contributions arising from transitions to nonanalog final states in the case of ^{10}B and ^{7}Li are of the same order of magnitude as pure analog cross sections. (auth)

24720 MULTISTEP CORE-EXCHANGE ANALYSIS OF ^{16}O+^{12}O SCATTERING WITH THE FULL-RECOIL CALCULATION.

Imanishi, B. (Institute for Nuclear Study, University of Tokyo, Tanashi, Tokyo, Japan); Kubo, K. Phys. Rev. Lett. 36: No. 3, 132-135 (19 Jan 1976).

Multistep core-exchange analysis has been performed for the scattering of $^{16}O+^{18}O$ at four different incident energies. It has been found that the recoil effects are very important for reproducing the energy dependence of the observed cross sections. The multistep effects due to the core-exchange process are very small. (auth)

24721 FEATURES OF THE (*t,p*) REACTION BELOW THE COULOMB BARRIER OF THE ENTRANCE CHANNEL. Iwasaki, Y. (Department of Physics, Shizuoka University, Shizuoka, Japan); Murata, T.; Tamura, T.; Nogami, Y. Phys. Rev. C 13: No. 2, 556-567 (Feb 1976).

The differential cross sections for the reactions $^{63,65}Cu(t,p)^{65,67}Cu$ were measured at E_t=3.2, 3.0, and 2.8 MeV. For L=0 ground-state transitions, the energy dependence of the values of the differential cross sections is strong and exponential, while the angular distribution shape, which is of a clear diffraction pattern in sharp contrast to the case of the sub-Coulomb (*d,p*) reaction, does not change with small energy variation. The reactions proceed well below the Coulomb barrier of the entrance channel, yet through a direct process. A definite difference is observed between the angular distributions for the two ground-state transitions. The zero-range distorted-wave Born approximation can reproduce the energy dependence of the differential cross sections and the trend of isotope dependence of the angular distribution. In distorted-wave Born approximation calculations, a definite nuclear optical potential is needed for the triton-nucleus channel which is below the Coulomb barrier, in sharp contrast to the sub-Coulomb (*d,p*) reaction. The triton-nucleus optical potential below the Coulomb barrier is nearly equal to the optical potential that works at energies of a few tens of MeV. The angular distribution for an L=2 transition is forward-rising, though not diffractionlike, and can be reproduced on the whole by the zero-range distorted-wave Born approximation. It is confirmed for the first time that the (*t,p*) reaction below the Coulomb barrier of the entrance channel takes place in an extended region outside the nucleus. It is argued and concluded on various grounds that the (*t,p*) angular distribution shape below the Coulomb barrier of the entrance channel is sensitive to the radial two-neutron form factor outside the nucleus. Physical implications of the revealed features are discussed, especially on the coherence of the two-particle form factor and the proton and neutron distributions in the nuclear surface region. (auth)

24722 APPLICATION OF SOME GENERAL RESONANCE RELATIONS TO EXCITATION FUNCTION DATA. Soga, M.; Bernstein, E.M. (Western Michigan University, Kalamazoo, Michigan 49001). Phys. Rev. C 13: No. 2, 473-476 (Feb 1976).

The usefulness of analyzing resonance excitation function data with a general relation is discussed and demonstrated. Inelastic scattering data over the 9.14 MeV anomaly in ^{12}C+ proton is consistent with a doublet with equal or nearly equal resonance energies for the two levels. A relation describing the energy dependence of experimental quantities which involve the ratio of resonating cross sections is derived and applied to the case of spin-flip probabilities in inelastic scattering. (auth)

24723 $^{14}N(p,\alpha)^{11}C$ CROSS SECTIONS FROM 3.8 TO 6.4 MeV. Ingalls, P.D.; Schweitzer, J.S.; Anderson, B.D. (California Institute of Technology, Pasadena, California 91125); Rios, M. Phys. Rev. C 13: No. 2, 524-527 (Feb 1976).

Total cross sections for the $^{14}N(p,\alpha)^{11}C$ reaction have been measured by using sealed gas targets and detecting annihilation radiation from the positron decay of ^{11}C. These measurements agree with the recent work of Jacobs *et al.* above 5.0 MeV and extend the measured cross sections to 3.8 MeV, where the cross section is a factor of 1000 smaller than the higher-energy cross sections. The results determine the low-energy normalization of the inverse $^{11}C(\alpha,p)^{14}N$ reaction, reducing the ^{14}N production in big bang model calculations relative to results obtained by using estimated cross sections. (auth)

24724 $^{19}F(d,\alpha_0)^{17}O$ AND $^{19}F(d,\alpha_1)^{17}O$ REACTION EXCITATION FUNCTION MEASUREMENTS BETWEEN 2.34 AND 14.45 MeV. Bigler, R.E.; Zaidi, S.A.A.; Horton, J.L.; Seitz, H. (Center for Nuclear Studies, University of Texas at Austin, Texas 78712). Phys. Rev. C 13: No. 2, 528-535 (Feb 1976).

The $^{19}F(d,\alpha_0)^{17}O$ and $^{19}F(d,\alpha_1)^{17}O$ reactions have been studied by measuring excitation functions in 30 keV steps over the energy range between 2.34 and 14.45 MeV deuteron energies. Cross-section data were collected simultaneously at laboratory angles of 70°, 90°, 120°, 150°, and 170°. The measured excitation functions exhibit strong resonance structures superimposed upon a smoothly varying component. The widths of these resonances are on the order of 300 keV. The corresponding excitation energy of the compound nucleus ^{21}Ne ranged between 19 and 25 MeV. A narrow region encompassing one of the strongest resonances was measured in smaller steps to look for finer structure. No evidence for fine structure greater than 10 keV was observed. (auth)

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Refer also to abstracts 23385, 24658, 24660, 24699–24701, 24715, 24746, and 24758.

24725 (CONF-740701-, pp 95-105) PRODUCTION OF ISOMERS BY THE CYCLIC ACTIVATION METHOD. Salaita, G. N.; Eapen, P. K. (Southern Methodist Univ., Dallas). Jul 1974.

From second international conference on nuclear methods in environmental research; Columbia, Missouri, USA (29 Jul 1974).

In proceedings of the second international conference on nuclear methods in environmental research. (Missouri Univ., Columbia (USA). Coll. of Engineering).

The isomeric states formation cross sections for 14.8 MeV neutron reactions in Mg, Al, As, Y, In, Hf, Tl, Pb, and Bi were measured using the cyclic activation technique and a high resolution Ge(Li) detector. Isomeric activities originating from the various isotopes of lead and thallium were separated by proper choice of cyclic timing parameters and energy discrimination. Long lived isomeric and ground state activities were investigated through conventional activation method. The isomeric cross section ratios, sigma/sub m//sigma/sub g/ for six elements, were measured and compared to the theoretical predictions of the Huizenga-Vandenbosch method. The half-lives of short-lived activities were determined using a wide range time-to-pulse height converter and a multi-channel analyzer.

24726 (IPNO/TH-75-24) SHAPE TRANSITION IN THE NEUTRON RICH SODIUM ISOTOPES. Campi, X.; Flocard, H.; Kerman, A. K.; Koonin, S. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jun 1975. Contract AT(11-1)-3069. 28p. Dep. NTIS $4.00.

Mass spectrometer measurements of the neutron rich sodium isotopes show a sudden increase at ^{31}Na in the values of the two neutron separation energies. The spherical shell model naturally predicts a sudden decrease at ^{32}Na after the N equals 20 shell closure. It is proposed that the explanation for this disagreement lies in the fact that sodium isotopes in this mass region are strongly deformed due to the filling of negative parity orbitals from the 1f/sub 7/2/ shell. Hartree-Fock calculations are presented in support of this conjecture. (auth)

24727 (ISN-TS-75-2) STUDY OF THE REACTION $^{23}Na(p,t)^{21}Na$. Agard, M. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 30 Apr 1975. 69p. (In French). Dep. NTIS (US Sales Only) $4.50.

Thesis.

The reaction $^{23}Na(p,t)^{21}Na$ was studied by fabricating a Na target on a polystyrene support and by eliminating almost all traces of oxidation. Some studies were also made with Na on a Au target, but interferring reactions provide too large a background. Attempts were made to analyze the reaction within the framework of the collective models and the shell model. Although neither were completely satisfactory a simple model was derived from the shell model and the sequence of the first levels could be reproduced satisfactorily by using effective matrix elements. However the first two excited $5/2^+$ states could not be derived. (JSR)

24728 (TLU-32/75) $^{27}Al(d,n\gamma)$ REACTION AND BOUND ISOBARIC ANALOGUE STATES IN ^{28}Si. Lyttkens, J.; Bergqvist, I.; Lodin, G.; Nilsson, L. (Tandemacceleratorlaboratoriet, Uppsala (Sweden)). Apr 1975. 20p. Dep. NTIS (US Sales Only) $3.50.

The $^{27}Al(d,n\gamma)^{28}Si$ reaction has been used to study characteristics of bound isobaric analogue levels in ^{28}Si. Neutron energies were determined by time-of-flight techniques using a pulsed incident beam and a large liquid scintillation detector. The neutron detector was placed at 0° thus accentuating l_p= 0 transfer. Gamma rays in coincidence with neutrons were detected by a coaxial Ge(Li) spectrometer. The results show good agreement with previously measured branching ratios for the 6277, 8589, 9316 and 9381 keV levels in ^{28}Si. New information is obtained for the analogue of the 2139 keV level in ^{28}Al. The excitation energy is found to be 11 434.1 ± 0.7 keV and gamma-ray transitions are observed to T = 0 as well as T = 1 levels. An upper limit for the lifetime of 100 fs is estimated from the experimental results. (auth)

24729 ANOMALY IN THE $^{27}Al(p,p)$ EXCITATION FUNCTION AT THE THRESHOLD OF THE NEUTRON ANALOGUE CHANNEL. Bondouk, I.; Cenja, M.; Hategan, C.; Tanase, M. (Institutul de Fizica Atomica, Bucharest (Romania)). Phys. Lett., B; 59: No. 1, 27-28(13 Oct 1975).

An anomaly in the backward angle excitation function for the $^{27}Al(p,p)$ reaction at the $^{27}Al(p,n)$ threshold has been found. It is connected with a 2p zero-energy neutron single-particle resonance. (NL)

24730 UNUSUAL STRENGTH OF THE 5.14 → 1.27 MeV, $2^- \rightarrow 2^+$, TRANSITION IN ^{22}Ne. Merdinger, J. C.; Bozek, E.; Gehringer, C.; Stachura, Z. (Strasbourg-1 Univ., 67 (France)). Phys. Lett., B; 59: No. 1, 38-40(13 Oct 1975).

The lifetime of the 5.14 MeV excited state of ^{22}Ne was investigated by use of the electronic timing, recoil distance and Doppler shift attenuation techniques. A mean life $\tau = 1.2 \pm 0.3$ ps was obtained, corresponding to a transition strength of 9.8×10^{-6} W. u. for the E1 decay of this state. (NL)

24731 LEVELS OF ^{29}P FROM THE ^{28}Si(p,p'γ)^{28}Si REACTION. Kulkarni, R. G. (Marathwada Univ., Aurangabad, India). pp 104 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The gamma rays were produced by inelastic scattering of protons by the first excited state of ^{28}Si at 1.78 MeV. A 3 in. × 3 in. NaI(Tl) crystal was used to detect the gamma rays. Excitation curves for the 1.78 MeV gamma rays have been measured in the proton energy range from 4.6 to 5.0 MeV. Resonances were observed at E_p = 4.69, 4.89 and 4.95 MeV. At 4.69 and 4.89 MeV, the angular distributions of the 1.78 MeV gamma rays were measured. By comparison with theory, the corresponding compound levels of ^{29}P at 7.26 and 7.45 MeV were assigned spins and parities to be $\frac{5}{2}^+$ and $\frac{5}{2}^-$, respectively. (auth)

24732 HIGHER ISOSPIN STATES IN ^{36}Ar THROUGH ALPHA PARTICLE CAPTURE RESONANCES. Chakrabarty, D. R.; Eswaran, M. A.; Oza, H. H.; Ragoowansi, N. L. (Bhabha Atomic Research Centre, Bombay). pp 107-109 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

With a view to locating and studying the higher isospin states in the self-conjugate nucleus ^{36}Ar, the excitation function in the reaction ^{32}S(α,γ)^{36}Ar has been obtained in the bombarding energy range, E_α = 4.5 to 4.8 MeV. An isotopically enriched ^{32}S target of 10 keV thickness and a large volume NaI(Tl) scintillation detector for gamma rays were used. Two isolated resonances at E_α = 4.53 ± 0.01 and 4.69 ± 0.01 MeV have been located, corresponding to the excitation energy in ^{36}Ar of E_{ex} = 10.67 and 10.82 MeV respectively. The decays of these resonances have been determined as also the absolute strengths, to be 0.86 ± 0.13 eV and 2.2 ± 0.2 eV respectively. Angular distribution at the E_α = 4.69 MeV resonance has also been measured. Based on these measurements, possible spin and isospin assignments of these resonances are discussed. (auth)

24733 RESONANCE SPECTROSCOPY OF ^{30}Si IN THE EXCITATION ENERGY RANGE 14.276 MeV TO 15.022. Namjoshi, L. V.; Gupta, S. K.; Mahta, M. K. (Bhabha Atomic Research Center, Bombay). pp 116-118 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Excitation functions for the reaction ^{26}Mg(α,α)^{26}Mg from 4.185 MeV to 5.145 MeV lab. energy measured at angles 81°, 118°, 135° and 165° have been analyzed using R-matrix theory of nuclear reactions. The computer program MULTI coding the multilevel-multichannel expression for differential cross section has been used for the purpose. Shape analysis of the observed anomalies have resulted in identification of nine levels in the compound nucleus ^{30}Si. The excitation energies and spins and parities of these levels are 14.320(0^+), 14.376(0^+), 14.597(0^+), 14.647(2^+), 14.675(1^-), 14.718(3^-), 14.874(0^+), 14.918(3^-) and 15.022(4^+) MeV. Tentative determination of total widths and partial widths for (α, α) channel have been made. The average cross section differs from Rutherford cross section by about 30% at all angles except at 81%. The average cross section could be fitted with optical model even though the incident energy is about 2 MeV below the Coulomb barrier. (auth)

24734 ^{29}Si(α,n)^{32}S REACTION NEAR THRESHOLD. Balakrishnan, M.; Kailas, S.; Kerekatte, S. S.; Mehta, M. K. (Bhabha Atomic Research Center, Bombay). pp 130 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The low energy neutron cross sections are interesting both from nuclear spectroscopy points and of astrophysical points. We have measured the reactions ^{29}Si (α,n) ^{32}S just near the threshold in the energy range $E\alpha$ = 1.8 to 2.5 MeV after reducing background effects substantially. The (n,α) cross sections were obtained using reciprocity relations. The reaction shows some interesting structures of width around 80 keV wide and the alpha width, neutron width and reduced widths have been extracted for these structures. The possible significances of these structures are discussed. The average alpha strength function indicates an abnormal behavior in this region. (auth)

24735 UPPER LIMIT TO THE LIFETIME OF 9.709 MeV STATE IN ^{32}S BY BLOCKING TECHNIQUE. Kurup, M. B.; Sharma, R. P. (Tata Inst. of Fundamental Research, Bombay). pp 131-133 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The decay time of the compound nuclear state in the resonance reaction ^{31}P(p,α)^{28}Si at 872.4 keV incident proton energy has been measured. Single crystal of GaP is bombarded with 875 keV protons using molecular hydrogen beam at the Van de Graaff machine. Blocking patterns for the emitted α-particles are observed simultaneously along the two ⟨111⟩ directions, 71° apart, on plastic films. The analysis of the blocking dips revealed an upper limit of 4.2×10^{-11} secs for the 9.709 MeV state in ^{32}S. Volume analysis of blocking dips using Lindhards' calculation has been carried out to obtain better results. The importance of such measurements including the ones which could be carried out at the VEC facility are discussed. (auth)

24736 ENERGY LEVELS OF ^{31}P AND COLLECTIVE MODEL. Sood, P. C. (Banaras Hindu Univ., Varanasi, India); Joshi, P. C. pp 201-203 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The nuclei in the latter half of the 1d-2s shell show certain unusual characteristics which provide possible evidence for the change of nuclear shape from prolate to oblate spheroid. The energy levels of the nucleus ^{31}P are examined in this context, in the framework of strong coupling collective model. The Nilsson model potential has been used for the description of single particle states in the deformed field. The potential parameters, which lead to a reasonable assignment of Nilsson orbitals to the various levels, are determined and a rotational band structure for this nucleus is proposed. The results are compared with those from other investigators using other models. The implications of these assignments in respect to other nuclear properties, e.g., the interband and intraband transition probabilities, mixing ratios etc., are discussed. (auth)

24737 DEEP INELASTIC NUCLEON TRANSFER IN ^{16}O+^{27}Al REACTIONS AT 90 AND 100 MeV. Cormier, T.M.; Lazzarini, A.J.; Neuhausen, M.A.; Sperduto, A.; Van Bibber, K.; Videback, F.; Young, G.; Blum, E.B.; Herreid, L.; Thoms, W. (Massachusetts Institute of Technology Department of Physics and Laboratory for Nuclear Science, Cambridge, Massachusetts 02139). Phys. Rev. C 13: No. 2, 682-690 (Feb 1976).

Reactions induced by ^{16}O bombardment of ^{27}Al have been investigated using a time-of-flight spectrometer for E (^{16}O) =90 and 100 MeV. Systematics of the angular distributions vs mass transfer and Q value suggest that frictional collisions are important in the transfer channels. The magnitude of deep inelastic cross sections and quasielastic cross sections are compared with previous fusion cross section measurements and limiting angular momenta are deduced. (auth)

24738 HIGH-SPIN STATES OF THE $K^\pi = 3/2^+$ AND $1/2^+$ BANDS OF ^{23}Na. Gustafson, D.E.; Thornton, S.T.; Schweizer, T.C. (Department of Physics, University of Virginia, Charlottesville, Virginia 22903); Ford, J.L.C. Jr.; Miller, P.D.; Robinson, R.L.; Stelson, P.H. Phys. Rev. C 13: No. 2, 691-698 (Feb 1976).

The ^{12}C(^{15}N,α)^{23}Na reaction was used to populate high-spin states in ^{23}Na for incident ^{15}N E_{lab}=36 to 39 MeV. Angular distributions of the reaction α particles were measured and energy averaged σ (θ)'s have been compared to Hauser-Feshbach calculations. We present suggestions for the high-spin members of the $K^\pi = 3/2^+$ ground-state rotational band through the $21/2^+$ member and for the $K^\pi = 1/2^+$ band through the $17/2^+$ member. The proposed spin assignments are in good agreement with shell model calculations. (auth)

24739 ^{30}Si+^{14}N RADIATIVE CAPTURE. Zeller, A.F.; Piendl, H.S.; Davis, R.H.; Williams, M.E.; Delaune, C.I. (Department of Physics, The Florida State University, Tallahassee, Florida 32306); Holub, R. Phys. Rev. C 13: No. 2, 661-667 (Feb 1976).

Cross sections for the reactions ^{30}Si(^{14}N,γ)^{44}Sc^m and ^{30}Si(^{14}N,n)^{43}Sc have been measured at five bombarding energies in the 40 to 62 MeV range. Residual activities produced by the reactions are unique and sufficiently long-lived so that the reaction yields in thick targets of natural Si were measured off-line with a Ge(Li) detector. By unfolding the range-energy function, the cross sections were extracted

from the yields. The capture cross section increases from 7.5 to 22 μb over the bombarding energy range. The cross section for single neutron emission is 75 μb and constant within the errors of this experiment. A Blann-Plasil code calculation resulted in a value that is a factor of 10^3 lower. The experimental results have been analyzed to determine an upper limit on the moment of inertia of the excited compound nucleus. Values of the upper limit depend on the choice of optical model parameters and the radius parameter in the moment of inertia. (auth)

24740 PARTIAL DECAY WIDTHS OF RESONANCES IN ^{29}P. Tsoupas, N.; Hausman, H.J.; Gearhart, N.L.; Terry, G.H. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. C 13: No. 2, 510-523 (Feb 1976).

Absolute differential cross sections of the ^{28}Si(p,p')^{28}Si* (1.78 MeV) reaction have been measured for 12 scattering angles and at 88 different energies between bombarding energies of 3.0 to 5.2 MeV. In addition, 53 absolute cross sections of the ^{28}Si($p,p'\gamma$)^{28}Si angular correlations in the spin-flip geometry were also measured over the same energy region. From these and other data, the partial proton decay widths and phases of 14 resonances in ^{29}P were determined between excitation energies of 5.50 and 7.90 MeV. (auth)

24741 ^{37}Cl(^{3}He, $\alpha\gamma$)^{36}Cl REACTION: γ DECAY OF THE TWO LOWEST LYING $T=2$ STATES. Vernotte, J.; Fortier, S.; Langevin, M.; Maison, J.M.; Vergnes, M. (Institut de Physique Nucléaire, B.P. 1, 91406-Orsay, France); Wildenthal, B.H. Phys. Rev. C 13: No. 2, 461-472 (Feb 1976).

The ^{37}Cl(^{3}He, $\alpha\gamma$)^{36}Cl reaction was studied at 18 MeV, using an enriched $CaCl_2$ target. The γ rays coincident with the α particles emitted at forward angle were detected by two Ge(Li) detectors located at $\theta=90°$ and 125°. Forty-two levels were observed in ^{36}Cl, essentially those seen in the (p,d) reaction. The γ-decay schemes of the two lowest lying $T=2$ levels of ^{36}Cl (analogs of the first two levels of ^{36}S, $J^\pi=0^+$ and 2^+, respectively) have been determined. The lowest $T=2$ level at $E_x=4299.5\pm1.1$ keV, feeds three levels: $E_x=1165$ keV ($J^\pi=1^+$, 65±8%), $E_x=1601$ keV ($J^\pi=1^+$, 28±5%), and $E_x=2677$ keV ($J^\pi=1^+$, 7±3%). The second one at $E_x=7564\pm4$ keV feeds the levels at $E_x=1601$ keV (42±6%), $E_x=1960$ keV ($J^\pi=2^+$, 40±6%), and $E_x=2491$ keV ($J^\pi=2^+$, 18±4%). These decay schemes are compared with shell model predictions. Some other levels of ^{36}Cl are also discussed. (auth)

24742 K SHELL AUTOIONIZATION IN THE BETA DECAY OF ^{36}Cl. Ljubičić, A.; Jurčević, M.; Vlatković, M. (Institute Rudjer Bošković, Zagreb, Yugoslavia); Logan, B.A. Phys. Rev. C 13: No. 2, 881-882 (Feb 1976).

The K shell autoionization occurring in the β decay of ^{36}Cl has been measured to be $(22.1\pm3.8)\times10^{-4}$ K shell vacancies per emitted β particle. The experimental result is less than the only available theoretical prediction. (auth)

24743 ENERGY OF THE LOWEST $T=2$ STATE IN ^{20}F. Millington, G.F.; Hutcheon, R.M.; Leslie, J.R.; McLatchie, W. (Department of Physics, Queen's University, Kington, Ontario, Canada K7L 3N6). Phys. Rev. C 13: No. 2, 879-880 (Feb 1976).

The reaction ^{18}O(^{3}He, $p\gamma$)^{20}F has been used to populate excited states in ^{20}F. One of these states at an excitation energy of 6519±3 keV has been identified with the analogue of the ^{20}O ground state. The mass excesses of the four known $T=2$ states for $A=20$ are in accord with the isobaric mass multiplet equation. (auth)

24744 HIGH SPIN STATES IN ^{23}Na AND THE $E_{c.m.}=19.3$ MeV ^{12}C+^{12}C RESONANCE. Back, B.B.; Betts, R.R.; Gaarde, C.; Oeschler, H. (Niels Bohr Institute, University of Copenhagen, 2100 Copenhagen, Denmark). Phys. Rev. C 13: No. 2, 875-878 (Feb 1976).

Lifetime and angular correlation measurements of the γ decays of the 9.04- and 9.81-MeV levels in ^{23}Na have been performed. These results are consistent with the identification of these two states as the $15/2^+$ and $17/2^+$ members of the ^{23}Na ground state rotational band. These spins, together with other considerations, suggest $J^\pi=12^+$ for the $E_{c.m.}=19.3$ MeV ^{12}C +^{12}C resonance. (auth)

24745 EXCITATION OF ANALOGS OF GIANT DIPOLE STATES VIA THE REACTION ^{27}Al(n,p)^{27}Mg. Brady, F.P.; King, N.S.P.; McNaughton, M.W. (Crocker Nuclear Laboratory and Department of Physics, University of California, Davis, California 95616); Satchler, G.R. Phys. Rev. Lett. 36: No. 1, 15-18 (5 Jan 1976).

Analogs of giant-dipole-resonance states have been excited in ^{27}Mg via the ^{27}Al(n,p)^{27}Mg reaction using 56.1-MeV neutrons. This reaction is restricted to $\Delta T=1$ transitions and thus provides a unique way of studying the $T_>$ components of the giant dipole resonances. A comparison with photonuclear and (p,p') spectra is made in an attempt to separate $T_>$ from $T_<$ components and $E1$ from the overlapping $E2$ isoscalar resonances. (auth)

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Refer also to abstracts 24658, 24660, 24685, 24686, 24688, 24702, 24786, 24787, 24885, 24918, and 24944.

24746 (CRN/PN-75-36) LIFETIME AND G-FACTOR MEASUREMENTS IN ^{44}Sc. Chevallier, A.; Chevallier, J.; Gross, J. L.; Haas, B.; Schulz, N.; Styczen, J.; Toulemonde, M. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1975. 12p. Dep. NTIS (US Sales Only) $3.50.

The lifetimes of the 235 keV, 2^- state and 350 keV, 4^+ state in ^{44}Sc have been measured via the ^{44}Ca(p,n)^{44}Sc reaction with a pulsed proton beam. The time integral perturbed angular distribution technique with an external field was used to measure the precession angles of the 2^- and 4^+ states populated by the ^{30}Si(^{16}O,pnγ) ^{44}Sc reaction. The following values for the mean-lives and g-factors were obtained: $\tau(2^-)=8.83$ (33) ns, $g(2^-)=0.30$ (13) and $\tau(4^+)=4.52$ (27) ns, $g(4^+)=0.90$ (12). The results for the 2^- state support a rotational description of the negative parity states in ^{44}Sc. The magnetic moment of the 4^+ state is compared to shell model predictions. 1 table, 2 figures. (auth)

24747 BETA DECAY TO THE FIRST 2^+ EXCITED STATE OF ^{42}Ca. Reddy, B. V.; Raju, M. L. N.; Sastry, D. L. (Andhra Univ., Visakhapatnam, India). pp 13-15 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The directional correlation between non-unique first-forbidden 2 MeV beta and the 1.52 MeV gamma-ray in the decay of K-42 has been measured as a function of beta particle energy in the range 350 to 1850 keV employing a fast-slow scintillation assembly. Nuclear matrix elements governing the 2 MeV beta transition are extracted using the accurate formalism of Buhring that are modified by Simms. The value of λ, the correction term in the expression of Damgaard and Winther for the vector matrix element ratio, is found to be 1.17 ± 0.37. Simple shell model configurations for the involved states in the transition could not explain the results on experimental matrix elements. (auth)

24748 COULOMB EXCITATION OF LEVELS IN ^{53}Cr. Kulkarni, R. G.; Patarwale, P. N. (Marathwada Univ., Aurangabad, India). pp 26-28 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The excited states of ^{53}Cr were investigated by means of Coulomb excitation using 5.5 to 7.2 MeV α-particle projectiles. The de-excitation gamma rays were studied with the aid of a 25 cm^3 high-resolution Ge(Li) detector. Six excited states in ^{53}Cr were populated by direct E_2 excitation up to an excitation energy of 2322 keV. Energy level measurement with an accuracy of ±2 keV and $B(E_2)$ values obtained (in units of e^2f^4) are as follows: 564 keV, 100.0 ± 0.5; 1006 keV, 115.6 ± 0.8; 1287 keV, 253.7 ± 1.8; 1539 keV, 28 ± 2; 1970 keV, 195.4 ± 5.2; 2322 keV, 147.8 ± 5.3. The measured $B(E_2)$ values are compared with the predictions of a Core-excitation model of de-Shalit. (auth)

24749 NUCLEAR STRUCTURE STUDY OF ^{50}V BY THE ^{50}Ti (p,nγ)^{50}V REACTION. Gupta, S. K.; Saini, S.; Namjoshi, L. V.; Mahta, M. K. (Bhabha Atomic Research Centre, Bombay). pp 42-44 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The information on gamma ray transitions, branching ratios, spins and parities of low-lying levels of ^{50}V has been obtained by Ge(Li)-Ge(Li) coincidence measurements. Comparison of the experimental results has been made with the calculations using lowest senority shell model wave functions. (auth)

24750 J-DEPENDENCE IN (d,p) REACTIONS AT LOW ENERGY. Mukherjee, S. N.; Shyam, R. (Banaras Hindu Univ., Varanasi, India). pp 61-62 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The $^2P_{\frac{3}{2}}$ $-^2P_{\frac{1}{2}}$ J-dependence in stripping angular distribution and the vector analyzing power for the (d,p) reaction in calcium isotopes at incident deuteron energy around 5.0 MeV has been

studied by coupled channel method and DWBA and the results are compared with experiments. It is shown that a large portion of J-dependence is caused by the coupling of the stripping channel to the incident deuteron channel. The necessity of including the deuteron break-up channel and the deuteron-D state is stressed.

24751 EFFECT OF STRIPPING CHANNEL ON ENERGY DEPENDENCE OF DEUTERON OPTICAL POTENTIAL. Pal, S. (Bhabha Atomic Research Center, Bombay); Srivastava, D. K.; Ganguly, N. K.; Mukherjee, S. N. pp 70-71 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Coupled-channel calculation has been done for ^{48}Ca, coupling the elastic and p-stripping channel at five energies of the incident deuteron, e.g., 5.0, 7.2, 10.0, 13.0 and 16.0 MeV. The stripping cross sections are in good agreement with experimental data. The calculated elastic scattering cross sections fit the experimental values qualitatively. Coupling of reaction channels is expected to remove energy dependence of the optical potential used in the elastic channel excepting the intrinsic one. In case of ^{48}Ca, the energy gap between 0^+g.s. and 2^+ first excited state being large (3.83 MeV), the coupling of the most probable stripping channel is expected to remove most of the energy dependence. This was investigated by fitting the coupled-channel prediction for the elastic scattering cross section with a conventional optical model search code. The nature of the energy dependence of the d-^{48}Ca optical potential is similar mainly for the imaginary part as obtained by other workers in the case of ^{40}Ca both by coupled-channel analysis and analyzing elastic scattering data. (auth)

24752 ^{55}Mn(p,n) ^{55}Fe FROM E_p = 1.35 MeV TO 5.4 MeV. Kailas, S.; Viyogi, Y. P.; Saini, S. S.; Gupta, S. K.; Ganguly, N. K.; Mehta, M. K.; Banerjee, A.; Karskatte, S. S. (Bhabha Atomic Research Center, Bombay). pp 78-81 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The total (p,n) cross section for the reaction 55 Mn(p,n)^{55}Fe was measured in 5 keV steps using a 55 Mn target (~8 keV thick for E_p = 3 MeV) and a 4π-geometry neutron counter, from E_p = 1.35 MeV to 5.4 MeV. The excitation function exhibits a large number of resonances, some of which can be identified with the isobaric analogue states in the compound nucleus ^{56}Mn. The excitation function averaged over 200 keV energy interval is analyzed on the basis of optical model. Hauser Feshbach theory with Moldauer's modification is used to get the fit to the experimental data. The isobaric analogue resonance at E_p = 1.54 MeV is analyzed to get the spectroscopic factor. (auth)

24753 MEASUREMENT OF ISOTOPIC NEUTRON CAPTURE CROSS SECTIONS FOR ^{51}V, ^{63}Cu, ^{71}Ga, ^{74}Ge, ^{75}As, $^{98\ 100}$Mo, ^{104}Ru, ^{115}In, $^{128\ 130}$Te, $^{140\ 142}$Ce, ^{165}Ho AT E_n = (25 ± 5) keV. Anand, R. P. (Bhabha Atomic Research Center, Bombay); Bhattacharya, D.; Jhingan, M. L.; Kondaiah, E. pp 101-103 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The isotopic neutron capture cross sections of a number of nuclei have been measured, the majority of which are fission products, at the neutron energy (25 ± 5) keV. The neutrons have been obtained from the monoergic filtered neutron beam facility that we have developed at the reactor CIRUS, B.A.R.C. This gives a flux of ~10^5 n/cm^2/sec. over an area of 3'' diameter. The gamma-ray activation technique has been employed which enables one to get the isotopic cross section values directly. For improved accuracy, our measurements have been done relative to the corresponding thermal values. By this procedure we have been able to bring down the errors considerably in most of the cases. The 441 keV gamma-ray coming from ^{127}I(n,γ)^{128}I has been used as a flux monitor. The data has been analyzed within the framework of Lane and Lynn's theory of neutron capture assuming the inelastic processes to be negligible at this energy. The analysis yields the p-wave neutron strength functions. (auth)

24754 GAMMA DECAY IN PROTON CAPTURE REACTIONS IN ^{49}Ti. Prabhakara, H. R.; Mehta, G. K. (Indian Inst. of Tech., Kanpur). pp 113-115 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

In 1f$_{\frac{7}{2}}$ nuclei the compound nuclear states reached by proton capture reactions using low energy accelerators are still observable as isolated resonances, some of which can be identified as isobaric analogue resonances having simple structure. In ^{49}Ti at proton energies 1.387 MeV and 1.564 MeV, 8.115 and 8.289 MeV levels are excited respectively in ^{49}V. None of these are known to be analogue resonances. The resonance at 1.564 MeV has a simpler decay scheme as compared to the one at 1.387 MeV. The decay properties of these resonances will be discussed. (auth)

24755 SPECTRA OF DOUBLE ODD NUCLEI. Saini, S.; Gupta, S. K. (Bhabha Atomic Research Center, Bombay). pp 206-209 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The energy levels of doubly odd nuclei like ^{48}Sc and ^{50}V have been calculated. The two body residual interaction employed has been a schematic one consisting of a short range delta-function plus a long range quadrupole-quadrupole interaction. We have assumed neutron and proton senorities to be good quantum numbers and used the lowest senority wave-functions in all these calculations. The experimental spectra are satisfactorily fitted when the parameters of the interaction are suitably adjusted. (auth)

24756 SPECTRAL DISTRIBUTION STUDY OF NUCLEI IN 2p-1f SHELL. Haq, R.; Parikh, J. C. (Physical Research Lab., Ahmedabad, India). pp 214-216 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Systematics of nuclei in the beginning of fp-shell are investigated using the spectral distribution method of French. The centroid energies and widths for various distributions are evaluated using the interaction of Kuo with the modification suggested by McGrory et al. The two moment distributions are used to determine ground state energies, fractional occupancy of the single particle orbits for ground states and low lying spectra of various nuclei in this shell. The results are compared with the deformed configuration mixing calculations of Dhar et al. Bearing in mind the accuracy and limitations of the method, the binding energies of nuclei are given well despite the large variations in the dimensionalities of the spaces that we are working with. We observe, however, that as the spaces encountered become larger one needs to do a finer averaging. We have also investigated the goodness of Wigner SU(4) symmetry in these nuclei. The mixing of various SU(4) representations near the ground state provide a measure of symmetry mixing and the substantial admixture in most of the cases show that it is badly broken, largely due to the single particle spin orbit coupling. (auth)

24757 TWO-PARTICLES AND TWO-HOLES-CORE EXCITATION EFFECTS. Shelly, S.; Bansal, R. K. (Panjab Univ., Chadigarh, India). pp 218-220 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The formalism for calculating the effects of two-particle and two-hole excitations accompanied by the isospin excitations of the target nucleus on the structure of the final nucleus states obtained via single proton transfer has been presented. The target considered has a neutron filled orbit outside a doubly closed shell-inert core and the proton is added to one of the empty orbits. The energies, wave functions and spectroscopic factors have been calculated for $\frac{3}{2}^-$ excited states of ^{49}Sc nucleus and $\frac{5}{2}^-$ excited states of ^{61}Cu nucleus using some standard two body interactions. A comparison of the present results with those obtained by taking into account only the already known isospin excitations of the core indicates that the two-particle two-hole excitation of the target results in many more, l = 1 and l = 3 states in the ^{49}Sc and ^{61}Cu spectra respectively than allowed otherwise. Experiments seem to confirm such a trend. (auth)

24758 CORIOLIS COUPLING EFFECTS ON THE MAGNETIC MOMENTS OF ODD-A AND ODD-ODD NUCLEI. Garg, V. P.; Sharma, S. D. (Punjabi Univ., Patiala, India). pp 233-235 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Bohr and Mottelson's symmetric core model was extended to the case of odd-A nuclei by Chi & Davidson and further to odd-odd nuclei by Sharma and Davidson. The model consists of rotating core inert to vibrations and odd nucleon (s) moving in deformed harmonic oscillator potential well (s) with l.s. and l.l terms. The odd- nucleon (s) is (are) taken according to single particle

Nilsson orbitals. The total Hamiltonian consists of rotational part, Nilsson's Hamiltonian(s) for odd nucleon (s), (and the residual particle interaction for odd-odd nuclei). Jagdev and Sharma reported coriolis coupling effect on Moments of Inertia of odd-A and odd-odd nuclei. They also reported magnetic moment of these nuclei without configuration mixing. In the present study, coriolis coupling (which accounts for $\Delta K = \pm 1$ mixing) has been used to calculate magnetic moments of some of deformed odd-A and odd-odd nuclei. (The effect of double Coriolis coupling is used for the states with $K = 0\pm, 1\pm$). The results are found in better agreement with experimental reports. (auth)

24759 BINDING ENERGY SYSTEMATICS IN 1f–2p SHELL NUCLEI. Dhar, A. K.; Kulkarni, D. R.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 243-245 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

Binding energy (B.E.) systematics has been studied in the framework of deformed configuration mixing formalism for the isotopes of Ti(A = 44–52), V(A = 47–51), Cr(A = 48–52, Fe(52, 54) and Ni(56), using the modified Kuo-Brown interaction and ^{41}Ca single particle energies. Contribution to B.E. arising from two-particle two-hole excitation within fp shell have been estimated through second order perturbation calculation. The experimental and theoretical values in general are in good agreement. Deviations in B. E. for higher mass nuclei indicate the modification in T = 0 part of the chosen effective interaction. Some comments would be made in this regard. (auth)

24760 SHAPE INDETERMINACY AND SPECTRUM OF ^{51}V. Dhar, A. K.; Khadkiker, S. B.; Kilkarni, D. R.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 246-248 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

The deformed configuration mixing calculations performed in the framework of projected Hartree Fock (HF) formalism lead to the indeterminancy of ground state shape for the nucleus 51V. Multiple HF solutions of almost equal deformation ($|10|\ b^2$) have been obtained within about 0.5 MeV of each other. This indicates lack of collectivity at shell closure. Because of the dominance of $(f^1_{\frac{7}{2}})$ configuration in the low-lying states of 51V, except for the lowest $J = \frac{3}{2}$ and $\frac{5}{2}$ states, large overlaps are obtained for the states projected from the above intrinsic states. The observed low-lying $J = \frac{3}{2}$ and $\frac{5}{2}$ states of 51V are found to belong dominantly to the oblate and prolate $K = \frac{3}{2}$ intrinsic states respectively. The calculated spectra and B(E2) values are in good agreement. As in other N = 28 nuclei, besides the low-lying states of small intrinsic deformation, a band of states belonging to a highly deformed prolate intrinsic state is likely to exist quite low in the spectrum of 51V. B(E2) values for transitions between these highly deformed states have been calculated. (auth)

24761 COLLECTIVE STATES IN ^{48}V. Dhar, A. K.; Kulkarni, D. R.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 249-251 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259–P17B.

The structure of the low-lying collective states in ^{48}V has been studied in the framework of deformed configuration mixing formalism. For the ground state band of states, the reduced electric quadrupole transition probabilities have been calculated. The structure of the negative parity band of states observed recently in (^{16}O, pn) reaction is shown to be consistent with the description of a proton excitation from the $d_{\frac{3}{2}}$ state to the fp shell space. The observed values of the moment of inertia parameter is = 57.3 keV and the intrinsic electric quadrupole moment of 0.79b of the negative parity band of states are in very good agreement with the corresponding estimated values of 56.9 keV and 0.82b respectively. (auth)

24762 ENERGY LEVELS OF ^{53}Mn BY THE NILSSON MODEL. Chung, W. H. (Univ. of Alberta, Edmonton). J. Korean Nucl. Soc.; 7: No. 3, 207-211(Sep 1975).

The Nilsson model was used to predict energy levels of ^{53}Mn without taking band mixing into consideration. The results were compared with the experimental levels and the predictions with band mixing of Malik and Scholz. In both cases, with band mixing and without band mixing, the theoretical fit to experimental results is fair only for a few low lying levels. However, it is found that the present calculation fits rather better to experiment than the band mixing calculation as far as higher levels are concerned. (auth)

24763 (^{3}He,d) REACTIONS ON ^{58}Ni, ^{60}Ni AND ^{56}Fe NEAR THE COULOMB BARRIER. Baghdadi, A.; Seltz, R.; Magnac-Valette, D.; Bonneaud, G.; Gerardin, C. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Lab. des Basses Energies). Nucl. Phys., A; 253: No. 1, 20-28(17 Nov 1975).

Using spectroscopic information gained by earlier measurement of the proton bound states populated by stripping reactions, (^{3}He,d) reactions on ^{58,60}Ni and ^{56}Fe targets are studied at energies near the Coulomb barrier and evaluation is made of the vertex function $\langle \phi_d \bmod V_{pd}\ \phi_{^3He} \rangle$. This value is then used to determine spectroscopic factors for low-lying states in ^{57}Co. (NL)

24764 DEEP INELASTIC COLLISIONS IN THE INTERACTION OF 280 MeV ^{40}Ar WITH ^{58}Ni. Gatty, B.; Guerreau, D.; Lefort, M.; Tarrago, X.; Galin, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de Chimie Nucleaire); Cauvin, B.; Girard, J.; Nifenecker, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Nucl. Phys., A; 253: No. 2, 511-532(24 Nov 1975).

Masses and charges of all the nuclei with $5 \leq Z \leq 20$ produced in the reaction ^{40}Ar + ^{58}Ni have been identified using combined ΔE.E and time-of-flight techniques. Energy spectra, angular distributions and cross sections have been measured. The formation of an intermediate composite system, in which charge equilibrium is achieved, is discussed. Also, the transition between the quasi-elastic and the deep inelastic process is studied. The angular distribution behavior is shown to be related to the interaction time. The total cross section of the deep inelastic process has been found to be 700 mb and is compared to the evaporation residue cross section. (NL)

24765 SHELL STRUCTURE OF THE ^{58}Ni CHARGE DENSITY. Sick, I.; Bellicard, J. B.; Bernheim, M.; Bussiere de Nercy, A.; Frois, B.; Gillebert, A.; Huet, M.; Leconte, P.; Mougey, J.; Ho, P. X. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). pp 295-296 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A very high momentum transfer elastic electron scattering experiment performed at Saclay is reported. The experimental charge density is compared with various Hartree–Fock densities. (NL)

24766 DEUTERON BREAK-UP ON ^{40}Ca. Viatte, P.; Micek, S.; Mueller, R.; Lang, J.; Unternaehrer, J.; Teodorescu, C. M.; Jarczyk, L. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik). Phys. Lett., B; 59: No. 1, 35-37(13 Oct 1975).

The applicability of the particle-particle correlation method to obtain spectroscopic information on unbound states is investigated. Spins, parities and partial proton widths of some levels in ^{41}Sc have been determined from measurements of the reaction ^{40}Ca(d,n)^{41}Sc(p)^{40}Ca and compared with the results from elastic proton scattering. The resonance width is an important test for the reliability of DWBA calculations. (NL)

24767 STRUCTURE OF ^{51}V AND ^{53}Mn. Dhar, A. K.; Khadkikar, S. B.; Kulkarni, D. R.; Bhatt, K. H. (Physical Research Lab., Ahmedabad (India)). pp 83-84 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The results of a deformed configuration mixing calculation based on projected Hartree-Fock (H.F.) theory for the nuclei ^{51}V and ^{53}Mn are presented. The calculations are performed in the full fp shell space using the interaction that has given good agreement for the spectra of the ground state bands of states and also for the transition rate between the low-lying states of the nuclei in this region. (NL)

24768 DESCRIPTION OF TRANSITIONAL NUCLEI IN THE pf-SHELL WITH THE GENERATOR COORDINATE METHOD. Muether, H.; Goeke, K.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Allaart, K. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). pp 79-80 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The excitation spectra of ^{46,48}Ti, ^{50,54}Cr and ^{56}Fe are studied by the generator coordinate method. The effective interaction of Kuo and its modification by McGrory are used, the single par-

ticle energies are taken from ^{41}Ca. For almost all low lying states the mixing of states around the prolate and oblate minima is essential for a reasonable description. For the yrast states this already provides a very good approximation to the more complete generator coordinate method. For this prolate-oblate mixing the pairing correlations play an important role, since a direct mixing of states projected from prolate and oblate Hartree Fock solutions is negligible. In all cases the excitation energies of the yrast states show a good agreement with experiment, showing only little dependence on the forces used. For the description of non yrast states it is necessary to include more (Q,Δ)-points (≤10). (NL)

24769 SELF-CONSISTENT CALCULATIONS AT FINITE TEMPERATURES. Brack, M.; Quentin, P. (Niels Bohr Institutet, Copenhagen (Denmark)). pp 399-401 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Calculations have been done for the spherical nuclei ^{40}Ca, ^{208}Pb and the hypothetical superheavy nucleus with Z = 114, A = 298, as well as for the deformed nucleus ^{168}Yb. The temperature T was varied from zero up to 5 MeV. For T > 3 MeV, some numerical problems arise in connection with the optimization of the basis when calculating deformed nuclei. However, at these high temperatures the occupation numbers in the continuum are sufficiently large so that the nucleus starts evaporating particles and no equilibrium state can be described. Results are obtained for excitation energies and entropies. (NL)

24770 DEUTERON INDUCED PICKUP REACTIONS ON ^{41}Ca. Betts, R. R.; Gaarde, C.; Hansen, O.; Larsen, J. S. (Niels Bohr Institutet, Copenhagen (Denmark)); Van der Werf, S. Y. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versneller Instituut). Nucl. Phys., A; 253: No. 2, 380-394(24 Nov 1975).

The ^{41}Ca(d,t)^{40}Ca and ^{41}Ca(d,τ)^{40}K reactions have been investigated at a bombarding energy of 40 MeV. A distorted-wave analysis of the measured angular distributions and a sum-rule analysis of the resulting spectroscopic factors has enabled the identification of members of various particle-hole multiplets. Values obtained for the matrix elements of the $1f_{\frac{7}{2}} - 1d_{\frac{3}{2}}^{-1}$ effective interaction are in poor agreement with values obtained from other nuclei, but are reasonably well reproduced by calculations with a simple force. (NL)

24771 SELECTIVE POPULATION OF HIGH-SPIN STATES IN ^{50}Cr. Savelli, C.; Morando, M.; Signorini, C. (Univ., Padua). Lett. Nuovo Cim.; 15: No. 2, 33-38(10 Jan 1976).

The selective population of high spin states in chromium-50 was investigated by means of the reaction ^{46}Ca(^{12}C,2p)^{50}Cr. The cross section for the direct population in ^{50}Cr of a level with a given spin was calculated as a function of its possible excitation energy at the different ^{12}C bombarding energies. Angular momentum effects are shown, namely: that low spin states are preferentially populated at low excitation in the final nucleus and at low bombarding energy. Cross sections are discussed. (JFP)

24772 PHONON ADMIXTURES IN STATES OF ^{56}Fe EXCITED BY ^{3}He SCATTERING. Clarke, N. M. (King's Coll., London). J. Phys., G (London); 1: No. 8, 895-906(21 Oct 1975).

The elastic and inelastic scattering of ^{3}He ions from the 0_1^+, 2_1^+, 4_1^+ and 2_2^+ states of ^{56}Fe have been analysed using an anharmonic vibrational model with the coupled channels code JUPITOR-KARLSRUHE. Appreciable one-phonon admixtures are found for the so-called two-phonon states. Values derived for the reduced transition probabilities, B(E2), are in good agreement with experimental data providing the calculations use the radius of the imaginary potential. (auth)

24773 MEASUREMENTS OF g-FACTORS OF THE ^{41}Ca(15/2$^+$), ^{42}Ca(6$^+$), ^{200}Pb(12$^+$), AND ^{200}Pb(9$^-$) ISOMETRIC STATES. Young, L. E. Stony Brook, NY; State Univ. of New York (1975). 48p. University Microfilms Order No. 75-26,144.

Thesis (Ph. D.).

A series of time differential g-factor measurements of isomeric nuclear states in nuclei near closed shells has been made. The g-factors of two states were measured in the region of the closed shell at ^{40}Ca. The level of 3830 keV in ^{41}Ca was found to have g(^{41}Ca($15/2^+$)) equals +0.29(2). This value was used to check the particle-hole configuration of the ($15/2^+$) state. Using the configuration determined by the g-factor measurement, the value of the isospin dependent part of the particle-hole interaction was deduced to be b approximately 1.5 to 1.8 MeV. The measurement of g(6_1^+) equals -0.415(15) for the (nu f^6/sub 7/2/) state in ^{42}Ca was used to extract a value for f/sub 7/2/ neutron g-factor of g(f/sub 7/2//sup nu/) equals -0.58(4). The value of g(6_1^+) was also compared with the g-factors of neutron (f/sub 7/2/)/sup n/ states in the neighboring nuclei ^{41}Ca and ^{43}Ca, with the conclusion that the additivity of effective g-factors works well for these partially deformed states. Two states were investigated in the ^{209}Pb nucleus. The g-factors of the (nu i^{-2}/sub $13/2$/) 12^+ state and the (nu i^{-1}/sub $13/2$/nu f^{-1}/sub $5/2$/) 9^- state were measured to be g(^{200}Pb(12^+)) equals -0.157(6) and g(^{200}Pb(9^-)) equals -0.030(3). Using the measured values for g(^{200}Pb(9^-)) and g(^{42}Ca(6_1^+)), the anomalous orbital g-factors of the neutron in each region are extracted to be delta g/sub l//sup nu/ equals -0.02(3) and delta g/sub l//sup nu/ equals -0.03(4), respectively. These values are lower in magnitude than the present theory predicts, but are consistent with the delta g/sub l//sup nu/ derived from other g-factor measurements. (Diss. Abstr. Int., B)

24774 FIT OF THE ANALOG RESONANCES IN ^{46}Ti. Lukasiak, A.; Zych, W. (Institute of Nuclear Research, Warsaw (Poland)). Acta Phys. Pol., Ser. B; 4: 489-494(1973).

Calculations concerning some of the resonances in the excitation curve ^{45}Sc(p,p) in the energy range of incident protons E_p = 1.6–1.8 MeV are presented. Four resonances are considered as analog ones in the compound nucleus ^{46}Ti. (auth)

24775 DOUBLE β-DECAY NUCLEAR MATRIX ELEMENTS AND LEPTON CONSERVATION. Vergados, J.D. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 13: No. 2, 865-871 (Feb 1976).

The nuclear matrix elements involved in the double β-decay of ^{48}Ca, ^{130}Te, and ^{128}Te were calculated using realistic nuclear interactions and shell model nuclear wave functions. The double doorway state is not appreciably mixed in the ground state of the final nuclei. So the ground state transitions contain a small fraction of the sum rule. A lepton nonconservation parameter $\eta \lesssim 10^{-4}$ was deduced. (auth)

24776 TWO-NUCLEON TRANSFER REACTIONS INDUCED BY ^{16}O ON ^{42}Ca AND ^{48}Ca. Eisen, Y.; Fortune, H.T.; Henning, W.; Kovar, D.G.; Vigdor, S.; Zeidman, B. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 13: No. 2, 699-711 (Feb 1976).

The reactions ^{42,48}Ca(^{16}O,^{18}O)^{40,46}Ca and ^{42,48}Ca(^{16}O,^{14}O)^{44,50}Ti were studied at 56-MeV bombarding energy. Angular distributions for transitions to the ground and excited states of the residual nuclei and of the outgoing particles are analyzed in the framework of both "cluster" and microscopic distorted-wave Born-approximation calculations. The measured transfer cross sections are not described by calculations using optical-model parameters which fit elastic scattering. Agreement is substantially improved by a systematic change in the exit channel parameters. Cross sections for excited states relative to ground-state transitions are compared to relative strengths obtained from light-ion reactions and from simple shell-model calculations. (auth)

24777 MEAN LIVES AND OTHER PROPERTIES OF SOME LEVELS IN Ti. Rasmussen, V.K. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. C 13: No. 2, 631-637 (Feb 1976).

Several levels in ^{46,47,48,49,50}Ti from 1.5 to 4.3 MeV are observed in the resonant scattering of bremsstrahlung by natural Ti. Six levels may be given immediate isotope assignments from verified branching to first excited states, seven may be assigned by close agreement of energies and other characteristics with levels observed in other reactions, one has a possible dual assignment, and one cannot be assigned. Widths and mean lives are given as well as information on spins, mixing ratios, and branching ratios. (auth)

24778 THE *E*0-PAIR DECAY OF THE 0^+ SECOND EXCITED STATES IN ^{42}Ca AND ^{44}Ca. Ulrickson, M.; Hartwig, W.; Benczer-Koller, N.; MacDonald, J.R. (Department of Physics, Rutgers University, New Brunswick, New Jersey 08903); Tape, J.W. Phys. Rev. C 13: No. 2, 536-539 (Feb 1976).

The *E*0-pair decay branching ratio (Γ_π/Γ) for the 1.84-MeV (0^+) and 1.88-MeV (0^+) second excited states of ^{42}Ca and ^{44}Ca were measured. The states were excited by proton inelastic scattering. e^--e^+ pairs from the *E*0-decay were stopped in a carbon cylinder and the resulting annihilation radiation was detected in two NaI(Tl) detectors in triple coincidence with backscattered protons. The observed branching ratios are $(0.88 \pm 0.14) \times 10^{-3}$ and $(2.05 \pm 0.17) \times 10^{-2}$ for ^{44}Ca and ^{42}Ca, respectively, corresponding to monopole strengths of $\rho = 0.30 \pm 0.10$ and $\rho = 0.34 \pm 0.03$. These results are consistent with a theoretical description of these states which includes large admixtures of deformed state wave functions. (auth)

24779 COUPLED QUADRUPOLE-OCTUPOLE EXCITATIONS IN ^{44}Ca AND THE DECAY OF ^{44}K, ^{44}Sc^m AND ^{44}Sc^g. Coleman, G.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 13: No. 2, 847-858 (Feb 1976).

The decay of ^{44}K, ^{44}Sc^g, and ^{44}Sc^m to levels of ^{44}Ca have been studied. For decay of ^{44}K, approximately 125 γ rays have been observed using singles, Compton-suppression, and γ-γ-coincidence Ge(Li) spectroscopy. The decay data, used in conjunction with recent reaction

spectroscopy data, have led to the identification of 35 levels in ^{44}Ca that are populated in β decay. The levels below 4500 keV are discussed within the framework of multiple vibrations. The levels at (J^{π} in parentheses) 3661.53 (1$^-$), 3676.07 (2$^-$), 3711.80 (4$^-$), 3913.8 (5$^-$), and 4358.42 keV (3$^-$) are suggested as the two phonon quadrupole-octupole pentad. (auth)

24780 ^{48}Ti(p,^{3}He)^{46}Sc REACTION. Guichard, A.; Benenson, W.; Markham, R.G.; Nann, H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 13: No. 2, 540-547 (Feb 1976).

The reaction ^{48}Ti(p,^{3}He)^{46}Sc has been studied at an incident energy of 40.2 MeV with an energy resolution of 17 keV. Sixty levels have been observed below 3.7 MeV. A distorted-wave Born approximation analysis permitted L assignments for most of them. A comparison with the other information on ^{46}Sc is made. (auth)

24781 LEVELS OF ^{53}Mn WITH THE ^{52}Cr(^{3}He,d)^{53}Mn AND ^{52}Cr(^{7}Li,^{6}He)^{53}Mn REACTIONS. Gunn, G.D.; Fox, J.D.; KeKelis, G.J. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 13: No. 2, 595-607 (Feb 1976).

The levels of ^{53}Mn populated by the reactions ^{52}Cr(^{3}He,d)^{53}Mn at 24 MeV and ^{52}Cr(^{7}Li,^{6}He)^{53}Mn at 34 MeV were studied using the Florida State University quadrupole spectrometer. Angular distributions were taken from 5° to 60° for ^{52}Cr(^{3}He,d)^{53}Mn, and from 1° to 25° for the ^{52}Cr(^{7}Li,^{6}He)^{53}Mn reaction. Angular distributions show the expected L-dependent shapes which are well described by the distorted wave Born approximation. Relative spectroscopic factors are in excellent agreement with previous studies. The J-dependent shape of the (^{7}Li,^{6}He) angular distributions at forward angles is used to identify the 2.68 and 3.48 MeV levels as $p_{1/2}$, and the 4.07 and 4.43 MeV levels as $p_{3/2}$. Absolute spectroscopic factors for the two reactions are in very good agreement and are about 30% lower than the values of previous studies. Seventeen levels of ^{53}Mn above 6 MeV are observed in one or both reactions. Angular distributions for eight levels are extracted for the (^{3}He,d) reaction, including the three isobaric analog levels at 6.97, 7.54, and 8.03 MeV Several of the levels above 6 MeV exhibit angular distributions which might be interpreted as being for either $l = 3$ or $l = 4$ transferred. These levels are identified as g-wave final states on the basis of their strength and excitation energy. The spectroscopic factors for the unbound levels are derived by a technique of extrapolation of cross sections from the bound state analysis. The spectroscopic factors extracted for the isobaric analog levels are consistent with (d,p) results to the parent states, within the limitations of the analysis. (auth)

24782 GAMMA-RAY SPECTROSCOPY STUDIES OF THE LOWER EXCITED STATES OF ^{53}V. Pronko, J.G.; Bardin, T.T.; Becker, J.A. (Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). Phys. Rev. C 13: No. 2, 608-613 (Feb 1976).

Previously unobserved γ-ray decay modes of some excited states of ^{53}V were studied using the ^{51}V(t,$p\gamma$)^{53}V reaction at a bombarding energy of E_t=2.9 MeV. Reaction proton–γ-ray time coincident spectra were obtained using a variety of γ-ray detectors: a 10-cm×10-cm NaI(Tl) detector, a 4-mm×3.81-cm NaI(Tl) detector, a 3.81-cm×5.08-cm NE102 plastic scintillator, and a 20-cm^3 Ge(Li) detector. Lifetime information was deduced from both Doppler-shift attenuations obtained from the Ge(Li) γ-ray spectra, and direct measurements using the plastic scintillator for the γ-ray detector. Some of the measured excitation energies E_x(keV) and lifetimes τ_m are: (127.0±1.4,≤1 nsec); (227.8±1.6, 5.85±0.44 nsec); (1090.3±2.0, 2 psec ≤τ_m≤1 nsec);(1265.4±1.2, 1.6 psec ≤τ_m≤1 nsec); (1549.6±3.0, $0.11^{+0.12}_{-0.07}$ psec); (1652.5±3.4, ≥0.65 psec); and (1856.2±2.4, ≤0.04 psec). The experimental results were interpreted with respect to existing nuclear-model calculations and tentative spin assignments were made for a number of excited states. (auth)

24783 LIFETIMES OF ^{55}Co EXCITED LEVELS. Neal, G.F.; Chagnon, P.R. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 13: No. 2, 614-619 (Feb 1976).

Gamma-rays deexciting ^{55}CO levels have been studied in coincidence with deuterons detected in a particle telescope, in the ^{54}Fe(^{3}He,$d\gamma$)^{55}Co reaction. Excitation energies, relative γ-ray intensities, and Doppler-shift attenuations of 12 levels have been measured. Mean lifetimes and transition strengths are reported. The Doppler-shifted line shape of the 2164—0-keV transition has been analyzed and has been found consistent with the assumption of a single level. Lifetimes of selected levels are: 2164 keV, 125^{+25}_{-20} fs; 3301 keV, 50^{+20}_{-15} fs; 3322 keV, 45^{+15}_{-10} fs; 3641 keV, 300^{+150}_{-100} fs; 4163 keV, 30^{+15}_{-10} fs; 4714 keV, 300^{+200}_{-150} fs; 4719 keV, <30 fs; and 5172 keV, 10^{+10}_{-5} fs. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 24658, 24660, 24714, 24753, 24757, 24763, 24787, 24810, 24813, and 24888.

24784 (COO-2439-2) HIGH RESOLUTION NEUTRON TOTAL CROSS SECTION MEASUREMENTS WITH THE (A) ORNL LINAC AND (B) THE COLUMBIA UNIVERSITY'S NEVIS SYNCHROCYCLOTRON AND (C) WITH B.N.L.HFBR. Progress Report, April 1, 1975–March 31, 1976. Garg, J. B. (State Univ. of New York, Albany (USA). Dept. of Physics). Dec 1975. Contract AT(11-1)-2439. 37p. Dep. NTIS $4.00.

The research involved the measurement, analysis and interpretation of high resolution neutron total and partial cross sections in the neutron energy range of few eV to few hundred keV in the following nuclei: Bi, Ta, Natural Copper, Natural Zinc, separated isotopes of copper, iron and zinc, e.g., ^{54}Fe, ^{56}Fe, ^{58}Fe, ^{63}Cu, ^{65}Cu, ^{64}Zn, ^{66}Zn, ^{67}Zn, ^{68}Zn, ^{70}Zn and Mn, Co, V. Some of these measurements were performed with the Columbia University's neutron velocity selector and the measurements on separated isotopes of iron, copper and zinc were performed with the Oak Ridge electron linear accelerator. By using area and shape analysis of resonances, the data were analyzed to extract the values of resonance parameters such as resonance energies (E/sub o/), neutron widths (LAMBDA/sub n/), capture widths (LAMBDA/sub gamma/) etc. The systematics of these results were investigated in detail. The results of these investigations have been submitted for publication in professional journals. (auth)

24785 (ORNL/TM-5215) Cu(n,x gamma) REACTION CROSS SECTION FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.2 AND 20.0 MeV. Chapman, G. T. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 71p. Dep. NTIS $6.00.

Differential cross sections for the neutron-induced gamma-ray production from copper have been measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge Linear Accelerator (ORELA) was used to provide the neutrons and a NaI spectrometer to detect the gamma rays at 125^0. The data presented are the doubly differential cross section, d^{2}sigma/d OMEGA dE, for gamma-ray energies between 0.3 and 10.6 MeV for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 300 keV with higher resolution in the neutron energy is also presented. The experimental results are compared with previous measurements made at ORELA and with the Evaluated Neutron Data File (ENDF/B-IV, MAT 1295). 41 figures, cross section tables. (auth)

24786 COLLECTIVE MOTION IN THE pf-SHELL. Muether, H.; Allaart, K. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.); Goeke, K.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). pp 78 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Shape- and pairing vibrations have been studied in pf-shell nuclei employing the Generator Coordinate Method (GCM). The basis states were constructed by particle number and angular momentum projection from Hartree-Fock-Bogoliubov (HFB) states which had been constrained to have different values for their intrinsic quadrupole moments and pairing energies. A ^{40}Ca and axial symmetry were assumed in order to restrict the amount of computational labor. The interaction of Kuo as well as that modified by McGrory were used. Spectra for ^{46,48}Ti, ^{50}Cr, ^{56}Fe were calculated. (NL)

24787 LOW-LYING LEVELS IN ^{61}Ni. Williams, J. R.; Gould, C. R.; Nelson, R. O.; Tilley, D. R. (North Carolina State Univ., Raleigh (USA)); Rickel, D. G.; Roberson, N. R. (Duke Univ., Durham, N. C. (USA)). Nucl. Phys., A; 253: No. 2, 365-379 (24 Nov 1975).

Electromagnetic decay properties for seventeen states in ^{61}Ni have been examined by means of the ^{58}Fe(α,nγ)^{61}Ni reaction with E_α = 8 MeV and the ^{60}Ni(d,pγ)^{61}Ni reaction at E_d = 6 MeV. Mean lifetimes were obtained with the Doppler-shift attenuation method. Spins, parities, and mixing ratios were determined from angular correlation studies and linear polarization measurements. The combined results permit new J^{π} assignments of $^3/_2^-$, $^5/_2^-$, $^7/_2^-$, and $^9/_2^+$ for the levels at 1016, 1611, 2020, and 2123 keV, respectively. Experimental results, including transition strengths, are compared to shell model predictions. (NL)

24788 γ-WIDTHS OF ISOBAR ANALOG RESONANCES IN THE ^{60,62}Ni(p,γ)^{61,63}Cu REACTIONS. Kraft, O. E.; Naumov, Yu. V.; Sizov, I. V. (Radium Inst., Leningrad). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 59-63(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 70-74(1975).

The γ-widths and resonance forces of resonances in the (pγ) reaction on ^{60}Ni and ^{62}Ni are determined. The measurements were carried out on the EG-5 electrostatic generator at the Nuclear Physics Laboratory of the Joint Institute of Nuclear Research (E_p

max = 5 MeV). Results are displayed for the $p_{\frac{3}{2}}$ IAR of $^{60}Ni(p,\gamma)$ ^{61}Cu and the $p_{\frac{1}{2}}$ and $p_{\frac{3}{2}}$ IAR of $^{62}Ni(p,\gamma)^{63}Cu$. (2 figures, 1 table) (auth)

24789 LEVEL SCHEME OF ^{74}As. Lal, B. (Tata Inst. of Fundamental Research, Bombay); Argarwal, Y. K.; Bharathi, S. M.; Baba, G. V. K. pp 30-32 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The level scheme of ^{74}As has been studied through the $^{74}Ga(p,n)$ ^{74}As reaction. Gamma-ray and internal conversion electron mode cements were carried out using Ge(Li) detectors and a six gap electron spectrometer. The level scheme was established by γ-γ coincidence measurements. New levels at 372.7, 525.8, 532.8, 632.1, 731.6, 752.7, 758.3, 801.6, 902.9 and 1128.5 keV have been established. Lifetime measurements on some of the levels were also performed by gamma-electron delayed coincidence measurements. As a result, the half-life of 26.8 ± 0.5 ns observed in the earlier work and attributed to a level at ~278 keV has been found in the present work to correspond to a level at 258.9 keV. The half-lives of the 271.3 and 277.5 keV levels were measured to be 1.0 ± 0.1 ns and < 0.3 ns respectively. The reduced transition probabilities deduced from these measurements are compared with theoretical predictions, and the main configurations of a few levels are determined from this comparison. (auth)

24790 TEMPERATURE DEPENDENCE OF THE QUADRUPOLE INTERACTION IN Zn METAL. Devare, S. H.; Somayajulu, D.R.S.; Devare, H. G. (Tata Inst. of Fundamental Research, Bombay). pp 54-56 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

It is now known that the electric field gradient (EFG) experienced by the nucleus in a crystal lattice consists of two parts, one contribution from lattice ions and the other from conduction electrons. This EFG can be measured fairly accurately by the time differential perturbed angular correlation technique (TDPAC) if one knows the quadrupole moment of the nucleus in its excited state. ^{111}In is one of the few nuclei where the quadrupole moment of the excited state is known reliably. This state is also very suitable for studying the quadrupole interaction by TDPAC method. We have used this probe nucleus in hexagonal Zn lattice to study the temperature dependence of the quadrupole interaction. In such structures the EFG is axially symmetric ($\eta = 0$) which makes the mathematical analysis easier. (auth)

24791 ISOBARIC ANALOGUE STATES IN ^{64}Zn THROUGH PROTON CAPTURE BY ^{63}Cu. Roy, A.; Iyengar, K. V. K.; Jhingan, M. L. (Tata Inst. of Fundamental Research, Bombay). pp 98-100 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The reaction $^{63}Cu(p,\gamma)^{64}Zn$ has been studied in the proton energy range 1650-2750 keV using the Van de Graaff accelerator at B.A.R.C., Trombay. About 100 resonances were observed in the excitation function out of which the prominent ones at E_p = 1731, 1882, 2036, 2099, 2312, 2352, 2421 and 2479 keV have been identified as analogues of the ground and low-lying excited states of ^{64}Cu. The overall energy resolution was 2.5 keV. The Coulomb displacement energy for the isobaric pair ^{64}Cu-^{64}Zn has been deduced to be (9.63 ± 0.01) MeV. The spectra of γ-rays and their angular distributions have been obtained at resonances corresponding to the analogue of the ground and first four excited states of ^{64}Cu. The resonance strengths and the branching ratios for the γ-decay of the resonances will be presented. The M1 width of the γ-decay from the resonance at 1731 keV to the ground state of ^{64}Zn, (0.20 ± 0.04) eV, is in excellent agreement with the value 0.19 eV deduced from the log ft value of 5.3 of the β-decay of the parent analogue. (auth)

24792 EXCITED STATES IN ^{85}Sr FROM THE REACTION $^{85}Rb(p,n\gamma)^{85}Sr$. Basu, S. K. (Saha Inst. of Nuclear Physics, Calcutta). pp 119-121 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

In-beam γ-ray measurements following the reaction ^{85}Rb (p,nγ) ^{85}Sr have been undertaken with a high resolution 32.2 c.c. co-axial Ge(Li) detector at a proton energy of 3.8 MeV. Both natural as well as enriched (89.5%) rubidium nitrate targets were used. To identify the γ-rays due to (p,n) reaction, spectra were taken with the proton beam de-graded in energy by mylar absorbers. The following γ-rays with energies (in keV): 193.9, 231.6, 238.7, 409.6, 504.5, 535.7, 546.7, 612.0, 698.2, 767.5, 788.0, 821.2, 914.0, 1030.5, 1123.5, 1262.0, 1323.8 and 1588.5 have been assigned to be from levels below 1.9 MeV excitation in ^{85}Sr. Twelve levels are proposed to accommodate the observed transitions of which the levels at 785.4, 936.9, 1398.0 and 1588.5 keV have not been reported previously. The branching ratios for the proposed levels are deduced and the level structure is discussed in the light of recent experimental and theoretical investigations. (auth)

24793 SPURIOUS STATES IN MTDA METHOD. Surei, J. K.; Raj, R. (Kurukshetra Univ., India). pp 159-161 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The treatment for the elimination of four-quasiparticle O^+ spurious states in the modified Tamm-Dancoff approximation (MTDA) method is modified suitably in order to incorporate the neglect of one four-quasiparticle O^+ spurious state which was not eliminated in the MTDA calculation and its effect studied for the even Ni-isotopes. It is found that it affects the ground state energy significantly. Further, its effect on the transition rates connecting O^+ states with non-zero states will be presented and discussed. (auth)

24794 SHELL-MODEL CALCULATION OF ^{74}Ga. Ahalpara, D. P.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). pp 210-212 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The low-lying energy levels of ^{74}Ga are studied by simple shell-model calculation in which it is assumed that a proton hole in orbit $2p_{\frac{3}{2}}$ is coupled with neutrons in $2p_{\frac{1}{2}}$ and $1g_{\frac{9}{2}}$ orbits. The negative-parity states are assumed to arise from the configuration $\pi(2p_{\frac{3}{2}}^{-1})\nu[(2p_{\frac{1}{2}})^2\,(1g_{\frac{9}{2}})^2]$ while the positive parity states are assumed to arise from the configuration $\pi(2p_{\frac{3}{2}}^{-1})\,\nu[(2p_{\frac{1}{2}})^1\,(1g_{\frac{9}{2}})^4_{I=0}]$. The neutron-neutron effective interaction needed for the calculation was taken from the experimentally observed $(1g_{\frac{9}{2}}^{-1}\,1g_{\frac{9}{2}})$ multiplet in ^{90}Nb. To get the proton-neutron interaction, surface-δ interaction was used where the strength of the interaction was adjusted to fit the $(1g_{\frac{9}{2}})^2$ multiplet obtained through the particle-hole to particle-particle transform of $(1g_{\frac{9}{2}}^{-1}\,1g_{\frac{9}{2}})$ multiplet in ^{90}Nb. The recently observed low lying states of ^{74}Ga are 4^-, 3^-, 1^+. The model described above gives 4^- as the ground state and 3^- as the first excited state. (auth)

24795 INTERMEDIATE COUPLING MODEL DESCRIPTION OF ZINC ISOTOPES. Dikshit, J. J.; (Physical Research Lab., Ahmedabad, India); Singh, B. P. pp 213 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The properties of the negative parity states of ^{65}Zn, ^{67}Zn and ^{69}Zn are investigated in the framework of the intermediate coupling in the unified vibrational model. In the model, a quasineutron is coupled to an anharmonically vibrating core. The neighboring even-even (A-1) isotope is considered as a core. Observed properties of the core nucleus is used to describe its anharmonicities. The model as applied involves only few free parameters. Energy levels, electromagnetic transition rates, life times, static moments etc. have been calculated. The results of present calculations have been compared with experimental results. Drastic changes in electromagnetic properties of the isotopes are very well accounted for. Also, the model predicts the quadrupole moments of first 2^+ states of ^{64}Zn and ^{66}Zn. The experimental values should be close to −0.08 barn and −0.09 barn respectively. Further comments on the results for ^{69}Zn will be made. (auth)

24796 ELASTIC AND INELASTIC SCATTERING OF OXYGEN IONS FROM NICKEL AND GERMANIUM ISOTOPES. Cobern, M.E.; Lisbona, N.; Mermaz, M.C. (Département de Physique Nucléaire, C.E.N. Saclay, BP 2, 91190, Gif sur Yvette, France). Phys. Rev. C 13: No. 2, 674-681 (Feb 1976).

The elastic and inelastic cross sections for the scattering of $^{16,18}O$ ions from targets of $^{72,74,76}Ge$ and of ^{16}O from ^{64}Ni have been measured at a laboratory energy of 56 MeV. The angular distributions for the ground and first-excited (2^+) levels have been analyzed simultaneously by a coupled-equations search routine, and optical potentials determined. It is shown that this method reduces the ambiguity in the potentials. (auth)

24797 EFFECTS OF FINAL-STATE CHARGE EXCHANGE IN THE $(\pi,\pi N)$ REACTION ON NICKEL TARGETS. Monahan, J.E.; Serduke, F.J.D. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 36: No. 4, 224-225 (26 Jan 1976).

It is shown that the ratios of one-nucleon-removal cross sections by π^+ and π^- recently measured for ^{58}Ni and ^{60}Ni targets are in reasonable agreement with the Sternheim-Silbar modified impulse approximation that incorporates final-state-nucleon charge exchange. (auth)

24798 MASS-EXCESS PREDICTIONS FOR NEUTRON-RICH ISOTOPES NEAR IRON. Davids, C.N. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 13: No. 2, 887-889 (Feb 1976).

A mass equation due to Jelley *et al.* is used to predict the mass excesses of 42 isotopes near iron and the results are compared with other predictions and with experiments where possible. (auth)

24799 ^{84}Kr$(t,p)^{86}$Kr AND ^{86}Kr$(t,p)^{88}$Kr REACTIONS. Flynn, E.R.; Sherman, J.D.; Stein, N. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545); Olsen, D.K.; Riley, P.J. Phys. Rev. C 13: No. 2, 568-577 (Feb 1976).

The ^{86}Kr and ^{88}Kr nuclei have been studied by the ^{84,86}Kr (t,p) reactions at E_t=17.0 MeV. Energy levels up to 6400 and 4400 keV excitation in ^{86}Kr and ^{88}Kr, respectively, were observed. Differential cross sections for many excited states have been extracted from 12° to 50° c.m. for ^{88}Kr and 12° to 55° c.m. for ^{86}Kr. The data are compared with DWBA calculations in order to obtain the angular momentum (L) transfer as well as nuclear structure information. The excited L=0 strength leading to ^{86}Kr in the region where the pairing vibration is expected is found to be fractionated and about 2/3 of the intensity of the ^{86}Kr—^{88}Kr (g.s.) transition strength. Strong L=2 transitions are found above this excited L=0 strength in ^{86}Kr and appear to have their parentage in the pairing quadrupole state represented by the first 2+ level in ^{88}Kr. The ^{86}Kr spectrum and transition strengths as found in the (t,p) reaction are compared with the ^{86}Kr(p,p) and ^{87}Rb(t,α) experiments. (auth)

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Refer also to abstracts 24658, 24660, 24688, 24725, 24753, 24755, 24758, 24775, 24858, and 24860.

24800 (IEA-386) DIRECTIONAL CORRELATIONS OF γ^- TRANSITIONS IN ^{134}Xe. Gualda, J. M.; Saxena, R. N.; Zawislak, F. C. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Mar 1975. 12p. Dep. NTIS (US Sales Only) $3.50.

The directional correlations of coincident γ-transitions in ^{134}Xe have been measured using a Ge(Li)-NaI(Tl) spectrometer. Spin assignments have been made for the levels at 1920(3^+), 2136 (5^+), 2272(4^+), 2352(4^+), 2408(5^+), 2588(4^+) and 2867 keV (4^+). In addition previous spin assignments of levels at 1613(2^+) and 1731 keV (4^+) have also been confirmed. The multipole mixing ratios δ(E2/M1) obtained from the present data are; $\delta(405) = 0.80^{+0.1}_{-0.1}$, $\delta(433) = 0.08 \pm 0.06$, $\delta(540) = -1.92 \pm 0.1$, $\delta(595) = -0.32 \pm 0.20$, $\delta(621) = -0.76 \pm 0.05$, $\delta(677) = -0.32 \pm 0.02$, $\delta(766) = -2.4 \pm 0.2$, $\delta(857) = -0.64 \pm 0.1$, $\delta(948) = -0.40 \pm 0.10$, $\delta(1072) = -0.16 \pm 0.02$ and $\delta(1136) = 0.48 \pm 0.02$. (auth)

24801 (TID-26945) LEVELS IN $^{113-125}$In AS SEEN BY THE COULOMB EXCITATION AND (HI,xn) REACTIONS. Tuttle, W. K. III. (Tennessee Univ., Knoxville (USA)). Dec 1975. 138p. Dep. NTIS $6.00.

Thesis.

Having one proton hole in a major proton shell closing at Z equals 50 makes the odd mass indium nuclei prime candidates for description by the weak coupling model. The purpose of the Coulomb excitation study was to update the information on ^{115}In and to do a thorough study of ^{113}In for which little information is known. In the (HI,xn) study, it was hoped that the deformed rotation band could be found. For the Coulomb excitation measurements, four types of experiments were performed. First, using beams of 9.4, 10.0, and 10.6 MeV ^{4}He ions, gamma-ray yields were taken with an angle between the beam and the detector, theta, of 55°. With these data one can confirm existing level diagrams, look for new transitions, and measure B(E2)'s and branching ratios. Secondly, gamma-gamma coincidence measurements were performed with a 10.6 MeV ^{4}He beam to confirm the level diagrams and search for new transitions. Next, angular distributions were taken for a 10.0 MeV ^{4}He ion beam to determine spins, parities and mixing ratios. Finally, a beam of ^{16}O ions was used to determine the lifetimes of states whose decaying gamma rays showed Doppler broadening. For the ^{110}Pd(^{6}Li,3n)^{113}In measurements, two types of experiments were performed, both with a 24 MeV ^{6}Li beam. First gamma-gamma coincidences were performed to find new transitions feeding those states previously known. Next, angular distributions were performed to confirm old spin assignments and to establish a basis for assignments to new levels observed. (auth)

24802 LIFETIMES OF EXCITED LEVELS AND ELECTROMAGNETIC TRANSITION RATES IN ^{130}Te. Tikku, V. K.; Singh, H.; Sethi, B. (Saha Inst. of Nuclear Physics, Calcutta). pp 1-3 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The lifetimes of 2153.0(7^-) and 1819.3(6^+) keV levels in ^{130}Te populated in the decay of isomers of ^{130}Sb have been measured by the delayed coincidence technique using a time to amplitude converter. The results are: $T_{\frac{1}{2}}$(2153.0 keV, ^{130}Te) = 166 ± 6 nsec and $T_{\frac{1}{2}}$(1819.3 keV, ^{130}Te) = 9.0 ± 0.4 n sec. These results along with energy and intensity measurements of γ-transitions in ^{130}Te reported earlier by us have been utilized to deduce the transition probabilities. The large kindrance (~10^7) observed for the 333.7 keV (2153.0(7^-) — 1819.3(6^+)) transition compared to the s.p. Weisskopf estimate strongly supports the suggestion that the 2153.0 keV level arises due to a coupling between two neutrons of type $(2d^{-1}_{\frac{3}{2}}, 1h^{-1}_{\frac{11}{2}})_{7^-}$. The results of the experimental lifetime of the 1819.3(6^+) keV shall be compared with those obtained from two proton cluster core coupling model. (auth)

24803 CONVERSION COEFFICIENT MEASUREMENTS IN ^{144}Pr, ^{192}Pt, AND ^{192}Cs. Singh, N.; Bhati, S. S.; Dass, P.; Trehan, P. N. (Panjab Univ., Chadigarh, India). pp 4 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

K- and L-conversion lines' intensities have been measured in ^{144}Pr, ^{192}Pt and ^{192}Os using a double focusing β ray spectrometer of TIFR, Bombay. In addition, γ ray intensities have been measured in ^{144}Pr using a Ge(Li) detector. From these studies, K- and L-shell conversion coefficients of various transitions in ^{144}Pr, ^{192}Pt and ^{192}Os have been calculated. The existence of 1055 keV level in ^{192}Pt has been confirmed and a spin 2^+ has been assigned to this level. The spin assignment of 2^+ has been confirmed for the 1090 keV level in ^{192}Pt. The multipolarities of 296, 308 and 604 keV transitions in ^{192}Pt and 488 keV transition in ^{192}Os were found to be M1+ (99.0 ± 0.5)%E2, M1 + (96.5 ± 0.5)% E2, M1 + (79±5)%E2 and M1 + (9.4 ± 2)%E2 respectively. The multipolarities and "δ" values of these transitions agree well with the theoretical estimates from Kumar and Barangar model. A new level at 804(0^+) keV has been proposed on the basis of this model to account for the existence of 314.8 keV transition (multipolarity M1 + (87 ± 3)%E2) which can be fitted between 804 and 489 keV levels. (auth)

24804 K-CAPTURE PROBABILITY IN THE DECAY OF ^{139}Ce (140 d). Dasmahapatra, B. K. (Saha Inst. of Nuclear Physics, Calcutta). pp 5-7 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B).

The K-capture probability (P_K) for the 165.8 keV state of ^{139}La in the decay of ^{139}Ce(140 d) is determined by a method recently developed by us (B. K. Dasmahapatra and P. Mukherjee, J. Phys. A7(1974) 388). In this method P_K is determined from the analysis of the KX-ray γ ray sum-peak observed with a high resolution (500 eV) X-ray detector in a close geometry set up. The value of P_K obtained is 0.74 ± 0.06. As the EC feeding to the 165.8 keV state is 100% and it decays to the ground state through the 165.8 keV transition only, a measurement of the KX-ray intensity together with the use of known conversion coefficients of the 165.8 keV transition yield P_K = 0.72 ± 0.04. Using the weighted average of P_K determined as above the mass difference between ^{139}Ce and ^{139}La is observed to be 269^{+18}_{-12} keV in good agreement with the value 275 ± 15 keV obtained from the mass adjustments (A. H. Wapstra and N. B. Gove, Nuclear Data Tables A9 (1971)287). (auth)

24805 INTERNAL CONVERSION AND CORE POLARIZATION OF g-FACTORS. Subba Rao, B. N. (Tata Inst. of Fundamental Research, Bombay). pp 17-19 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Since 1959 there have been reported several measurements of the Nuclear structure (Penetration) effect in M1 internal Conversion in non-deformed as well as deformed nuclei. Very few of these can be explained with the present day nuclear models. Where such explanations have been attempted, only the numerator of the penetration parameter λ, i.e. the penetration matrix element has been evaluated with the model, resulting in signless (absolute) magnitudes for λ. The 1-forbidden M1 transitions are

of special concern in (non-deformed) retarded M1 transitions and here an effective operator approach is employed to evaluate not only the core polarization g-factor, g_p, but also the penetration parameters, λ, with their sign. In order to keep track of phase conventions in the definition of nuclear matrix elements, the amplitudes of multipole mixing ratio, $\delta(E2/M1)$ are also evaluated. With such simultaneous comparison of λ and δ from both experiment and theory, it is believed that a better picture emerges as to the nuclear structure information emerging from these penetration effect measurements. Odd-proton and odd-neutron 1-forbidden M1 transitions in ^{121}Te, ^{123}Te, ^{129}I, ^{133}Cs, ^{141}Pr, ^{143}Pr, ^{147}Pm, ^{149}Pm, (^{175}Lu, ^{181}Ta), ^{197}Au, ^{201}Tl, ^{203}Tl, ^{207}Tl, are considered in this work. (auth)

24806 LEVEL STRUCTURE STUDIES IN ^{99}Tc, ^{140}Ce AND ^{147}Pm. Bhati, S. S.; Singh, N.; Dass, P.; Traban, P. N. (Panjab Univ., Chandigarh, India). pp 25 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Energy and intensity measurements with considerable precision have been done in ^{99}Tc, ^{140}Ce and ^{147}Pm using a 8 cc Ge(Li) detector in conjunction with ND-1100 multichannel analyser. The technique of Gehrke et. al was used for energy and efficiency calibration. The accuracy obtained in energy and intensity measurements were of the order of 0.05 keV and 3-5 percent respectively. With this accuracy, it was possible to improve upon the previous values of energies and intensities. In addition, gamma ray coincidence spectra were taken in ^{140}Ce and ^{147}Pm using a Ge(Li)-NaI(Tl) fast-coincidence set-up. On the basis of single's as well as coincidence studies, the existence of 312 keV gamma ray in ^{147}Pm has been confirmed. Also, the existence of 722 keV level in ^{147}Pm has been confirmed. The 298 keV gamma ray proposed by H. Singh et. al has not been observed in the present study. (auth)

24807 LEVEL STRUCTURE OF ^{147}Pm. Sinha, B. K.; Sen, S.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). pp 39-41 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Level properties of ^{147}Pm have been studied from the decay of ^{147}Nd (11.1 d). Experimental set up consists of a pair of XP 1021 photomultiplier tubes coupled to high resolution Bicron 1½ inches x 1 inch NaI(Tl) phosphors and an overlap type of TAC set up using avalanche transistor pulse shaper. For detection of β-rays, 1 inch x ⅜ inch NE 102 plastic phosphors are used. Typical time resolution using NaI (Tl) phosphors for the ^{60}Co γ rays is 600 ps. Mean life of the 91, 410 and 531 keV levels have been determined by measuring the time distribution of the coincidence events between 870 keV β-91 keV γ rays, 275–319 keV γ rays and (370 keV β-ray–531 keV γ ray respectively. Mean lives of these levels deduced from centroid shift method are $\tau(91) = 3.80 \pm 0.04$ ns, $\tau(410) = 201 \pm 20$ ps and $\tau(531) \leq 10$ ps. Angular correlation of the 275-319 keV cascade has been remeasured with a view to clarify some anomalies in the previous results. Differential angular correlation measurement of the 319-91 keV cascade has also been undertaken. Experimental results are compared with theoretical calculations of the level structure of ^{147}Pm using core-particle coupling model. (auth)

24808 SPECTROSCOPY STUDY OF ^{107,109}Cd EXCITED STATES THROUGH ^{107,109}Ag (p,nγ) REACTIONS. Chatterjee, M. B.; Baliga, B. B.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). pp 45-47 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

(p,n) reactions are known to excite both the single particle states and collective states. Hence they are ideal to study the low-lying states of several nuclei where the Q-values are not too negative. The excited states of ^{107,109}Cd have been observed from the ^{107,109}Ag(p,nγ) reaction. In beam spectroscopic study of γ ray singles have been carried out with the Ge(Li) detector varying the proton energy from 3.0 to 5.25 MeV in steps of 250 KeV Van de Graaff accelerator of BARC. Energies and intensities of γ rays have been measured. Some of the levels which were weakly populated in decay have been strongly excited in the reaction work. New γ lines have been observed which were not reported in our decay works earlier. Further support for the existence of these lines have been obtained from the published works on (p,n) and (d,p) reactions. Discussions on various levels of ^{107,109}Cd obtained from reaction data will be presented in the light of decay data of our earlier experiments and other published works in the literatures. (auth)

24809 CONSISTENT MICROSCOPIC AND PHENOMENOLOGICAL ANALYSIS OF COMPOSITE PARTICLE OPTICAL POTENTIAL. Mukhopadhyay, S. (Bhabha Atomic Research Center, Bombay); Srivastava, D. K.; Ganguly, N. K. pp 72-75 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

A microscopic calculation of composite particle optical potential has been done using a realistic nucleon-helion interaction and folding it with the density distribution of the targets. The second order effects were simulated by introducing a scaling factor which was searched on to reproduce the experimental scattering results. Composite particle optical potential was also derived from the nucleon-nucleus optical potential. The second order term was explicitly treated as a parameter. Elastic scattering of 20-MeV-3H on targets ranging from ^{40}Ca to ^{208}Pb have also been analysed using phenomenological optical model. Agreement of these results with above calculations verified the consistency of the microscopic theory. But the equivalent sharp radius calculated with n-helion interaction was observed to be smaller than phenomenological value. This was attributed to the absence of saturation effects in the density-independent interaction used. Saturation has been introduced by a density dependent term of the form $(1 - c\beta^{2/3})$, where β is the compound density of the target helion system. (auth)

24810 PHYSICALLY CONSISTENT FERMI GAS MODEL FOR NUCLEAR LEVEL DENSITIES. Jain, A. K.; Sood, P. C. (Banaras Hindu Univ., Varanasi, India). pp 85-88 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The conventional formulation of the Fermi gas model for calculating nuclear level densities gives correct results only over a limited energy range, defined by the experimental neutron resonance data; its predictions come out far too low at excitations near the ground state and too high for excitations above 15 MeV. A modification of the model—known as the back shifted Fermi gas model - yields a better agreement by treating the model parameters "a" and "Δ" as free, while keeping the spin cut-off parameter related to the rigid body moment of inertia as before. However, in this formulation one no longer has the straightforward identification of "a" and "Δ" with the level density parameter and the gap parameter, derivable both from the conventional approach to experimental data and the Strutinsky type calculations. We suggest that the anomaly is related to the energy dependence of the moment of inertia and proceed as follows. The gap parameter "Δ" is fixed from the experimental pairing energies, and the level density parameter "a" is determined from experimental resonance data using the rigid body estimate for the spin cut-off parameter σ. Taking "a" and "Δ" to be energy independent, the fits to low energy levels of these nuclei are obtained by varying σ. The results so obtained are used to discuss the energy variation of the moment of inertia as also to investigate the possibility of shell effects in such variations. (auth)

24811 CROSS-SECTIONS FOR (n,2n) REACTIONS AT 14 MeV. Lakshmana Das, N.; Srinivasa Rao, C. V.; Thirumala Rao, B. V.; Rama Rao, J.; Lakshminarayana, V. (Andhra Univ., Waltair, India). pp 105 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Activation cross-sections for the reactions ^{142}Nd(n,2n)^{141g}Nd, ^{146}Nd(n,2n)^{147}Nd, ^{160}Gd(n,2n)^{161}Gd and ^{162}Er(n,2n)^{163}Er have been determined at 14 meV using a 35 c.c. coaxial Ge(Li) detector and the mixed powder technique. The finite size of the target samples and their self-absorption effects for γ rays have been experimentally taken into account by calibrating the Ge(Li) detector for volume sources using the simulation technique. The measured cross-sections are compared with previous results using scintillation detectors and with various theoretical predictions. (auth)

24812 MEASUREMENT OF FAST NEUTRON SCATTERING AND TOTAL CROSS SECTIONS OF ^{141}Pr. Singh, R.; Knitter, H. H. (Indian Inst. of Tech., Kanpur). pp 110 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The differential elastic neutron scattering cross sections of ^{141}Pr were measured at incident neutron energies of 1.2, 1.7 and

1.9 MeV in the angular range between 25 and 150°. The 3 MeV Van de Graaff machine at C.B.N.M, Geel was used to obtain proton pulses of width 1 ns at 1 MHz repetition rate and a 495 $\mu g/cm^2$ TiT target for producing neutrons. The measurements were made with flight paths of 1.43 m at the incident neutron energies of 1.2 and 1.7 MeV and 2.3 m at 1.9 MeV. The over all time resolution was about 2.5 ns. At 1.7 MeV the differential inelastic neutron scattering cross sections corresponding to Q = −1122 keV, and at 1.9 MeV the ones corresponding to Q = −1122, and Q = −1295 keV were also determined. In a transmission experiment the total cross section was measured between 0.50 and 2.42 MeV. The total and differential cross sections were calculated using the nuclear optical model. The calculated results were compared with the experimental data. (auth)

24813 PAIRING VIBRATIONS IN ZIRCONIUM ISOTOPES. Ghosh, M. K.; Samanta, B. C. (Burdwan Univ., West Bengal, India). pp 165-167 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The Zirconium isotopes span an interesting region around the mass number A = 90. The stable isotope ^{90}Zr has a closed neutron subshell. The modified random phase approximation (MRPA) has been applied to study pairing vibrations in Zirconium isotopes. Pairing correlations in the ground state and the excited states of Zirconium isotopes have been calculated and compared with experimental results. For ground to ground state transitions our results are in good agreement with the experimental ones. The predicted excited O' pairing-vibrational states of Zirconium isotopes, however, occur at energies somewhat higher than those observed experimentally by Flynn et al. (auth)

24814 ISOTOPIC EFFECTS OF PHOTONUCLEAR REACTIONS ON NUCLEI HAVING A 100. Sorokin, Yu. I.; Yur'ev, B. A. (Inst. of Nuclear Physics, Moscow). Bull. Acad. Sci. USSR, Phys. Ser.; 39: No. 1, 98-104(1975).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: No. 1, 114-122(A > 100 1975).

The final results are presented for measurement of the cross sections of photoneutron reactions on a series of nuclei having A > 100, which were performed on the 35 MeV betatron of the Scientific-Research Institute of Nuclear Physics at Moscow State University; they are likewise compared with the results of measurements of the cross sections of (γp) reactions on ^{112}Sn, ^{124}Sn, and $^{207,208}Pb$ nuclei, which were performed earlier. (auth)

24815 COUPLED-CHANNELS EFFECTS FOR INELASTIC SCATTERING OF 15 MeV POLARIZED DEUTERONS FROM Ti AND Sm ISOTOPES. Baker, F. T.; Glashausser, C.; Robbins, A. B.; Ventura, E. (Rutgers—the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., A; 253: No. 2, 461-468(24 Nov 1975).

Cross sections and analyzing powers have been measured for elastic and inelastic scattering of 15 MeV deuterons from ^{148}Sm and ^{152}Sm. These data, as well as previous data for the $^{48,50}Ti$(d (pol,d') reaction, have been analyzed in the coupled-channels approximation. Data for ^{48}Ti and ^{152}Sm are better described by the rotational model than by the vibrational model but the quality of the fits is not sufficiently good to establish (d(pol),d') reactions as a sensitive method of discriminating between these two models. (NL)

24816 SHELL-MODEL SYSTEMATICS OF THE ZIRCONIUM AND NIOBIUM ISOTOPES. Gloeckner, D. H. (Rutgers—the State Univ., New Brunswick, N. J. (USA)). Nucl. Phys., A; 253: No. 2, 301-323(24 Nov 1975).

A shell-model description of the zirconium and niobium isotopes is presented that gives the systematic trends in energy levels and parentage for the isotopes with N = 50 through N = 56. The nucleus ^{88}Sr is taken to be an inert core with protons filling the ($2p_{\frac{1}{2}}$, $1g_{\frac{9}{2}}$) levels and neutrons the ($2d_{\frac{5}{2}}$, $3s_{\frac{1}{2}}$) levels. Two-body matrix elements are determined by a least-squares fit to energy-level data. One- and two-particle transfer, electromagnetic transition rates, and energy level data are examined. (NL)

24817 REACTIONS ^{118}Sn(d(pol),t) AND ^{98}Mo(d(pol),t). II. Interpretation of the $l_n = 0$ Results. Vigdor, S. E. (Wisconsin Univ., Madison (USA)). Nucl. Phys., A; 253: No. 1, 75-95(17 Nov 1975).

Measurements of the vector analyzing power at $E_d = 12.0$ MeV for $l_n = 0$ transitions in ^{118}Sn(d(pol),t)^{117}Sn and ^{98}Mo(d(pol),t)^{97}Mo are examined. A DWBA analysis reveals that the (d(pol),t) analyzing powers are sensitive to the deuteron-nucleus, but not to the triton-nucleus spin-orbit interaction. For the ground-state transition ^{118}Sn(d(pol),t_0)^{117}Sn, an unexpectedly strong correlation is observed between the measured analyzing power and the logarithmic derivative with respect to angle of the measured differential cross section. The correlation is shown to arise in part because the radial wave functions corresponding to a given partial wave penetrate considerably further in the deuteron channel than in the near-Coulomb triton channel. Under the conditions responsible for this correlation, the radius parameter of the deuteron-nucleus spin-orbit potential can be estimated directly from the (d(pol),t) analyzing power measurements, in a manner independent of optical model analyses of deuteron elastic scattering. The origin of correlations between the $l_n = 0$ analyzing power and that for deuteron elastic scattering from the same target nucleus, and between the analyzing powers for the reactions ^{118}Sn(d(pol), t_0)^{117}Sn and ^{117}Sn(d(pol),p_0)^{118}Sn is investigated. (NL)

24818 QUASIMOLECULAR Kx-RAY EXCITATION BY BOMBARDING La TARGETS WITH La AND Xe IONS. Frank, W.; Gippner, P.; Kaun, K. H.; Sodan, H.; Tretyakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). Phys. Lett., B; 59: No. 1, 41-44(13 Oct 1975).

The X-ray emission from 85 to 150 MeV Xe and 115 MeV La bombardments of thick natural La targets has been measured. The spectra and yields of X-ray emission are obtained. Continuous X-ray distributions have been found to lie beyond the target and projectile characteristic X-ray energies. The high-energy parts of these continua are interpreted as K-radiation of quasi-molecules with effective atomic numbers Z = 111 and Z = 114, respectively. (NL)

24819 REACTIONS ^{118}Sn(dpol,t) AND ^{98}Mo(dpol,t). I. Spectroscopy of ^{117}Sn AND ^{97}Mo. Vigdor, S. E.; Haeberli, W. (Wisconsin Univ., Madison (USA)). Nucl. Phys., A; 253: No. 1, 45-74 (17 Nov 1975).

The vector analyzing power and differential cross section have been measured at a deuteron energy of 12.0 MeV for ^{118}Sn(d(pol),t) transitions to six states of ^{117}Sn (E_x = 0.0, 0.16, 0.31, 0.71, 1.02, and 1.18 MeV), for ^{98}Mo(d(pol),t) transitions to eight states of ^{97}Mo(E_x = 0.0, 0.68, 0.72, 0.89, 1.12, 1.28, 2.39, and 2.52 MeV), and for ^{118}Sn(d(pol),d) and ^{98}Mo(d(pol),d). Deuteron optical model potentials were obtained from analysis of the elastic scattering measurements, and were used in a DWBA analysis of the (d(pol),t) results. Comparison of the measurements and DWBA predictions for $\sigma(\theta)$ and for iT_{11} (θ) allows unambiguous determination of l_n and j_n for all ^{118}Sn(d,t) and most ^{98}Mo(d,t) transitions. Differences in the triton energy relative to the Coulomb barrier cause marked qualitative differences in the measured cross sections and analyzing powers between ^{118}Sn(d(pol),t) and ^{98}Mo(d(pol),t) transitions of the same l_n and j_n. (NL)

24820 EXPERIMENTAL AND SHELL-MODEL STUDIES OF THE REACTIONS ^{91}Zr(d,p)^{92}Zr AND ^{90}Zr(t,p)^{92}Zr. Ipson, S. S.; McLean, K. C.; Booth, W.; Haigh, J. C. B. (Bradford Univ. (UK)); Glover, R. N. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Nucl. Phys., A; 253: No. 1, 189-215(17 Nov 1975).

The results of high-resolution studies of the ^{91}Zr(d,p) reaction at E_d = 12 MeV and the ^{90}Zr(t,p) reaction at E_t = 11.85 MeV are presented. Absolute cross sections have been measured for both reactions and (d,p) spectroscopic factors determined. A comparison of these results with earlier data has been made, and although many of the previous assignments have been confirmed, many new features concerning the structure of ^{92}Zr have been discovered. Shell-model calculations have been performed for ^{91}Zr and ^{92}Zr using a neutron space which includes the $2d_{\frac{5}{2}}$, $3s_{\frac{1}{2}}$, $2d_{\frac{3}{2}}$, $1g_{\frac{7}{2}}$ and $1h_{\frac{11}{2}}$ orbits and a proton space comprising the $1g_{\frac{9}{2}}$ and $2p_{\frac{1}{2}}$ orbits. Realistic proton-neutron and neutron-neutron interactions based on the Sussex matrix elements were used in the calculated for the ^{90}Zr(d,p) and ^{91}Zr(d,p) reactions and cross sections calculated for the ^{90}Zr(t,p) reaction. In general, good agreement between the theoretical and the experimental results has been obtained. (NL)

24821 (d,p) REACTIONS ON EVEN TELLURIUM NUCLEI. The ^{122}Te(d,p)^{123}Te REACTION. Lien, J. R.; Vaagen, J. S.; Graue, A. (Bergen Univ. (Norway). Dept. of Physics). Nucl. Phys., A; 253: No. 1, 165-188(17 Nov 1975).

The energy levels of ^{123}Te have been studied in the ^{122}Te(d,p)^{123}Te reaction at 7.5 MeV bombarding energy using the MIT multiple-gap magnetic spectrograph. More than one hundred levels were observed up to 5.5 MeV excitation energy. Angular distributions were measured and l-assignments given for 32 of the stronger proton groups. The level scheme was compared to results from IAR and radioactive decay studies. A new $\frac{1}{2}^+$ level was observed at 600 keV. A DWBA analysis was used to obtain spectroscopic amplitudes for orbits in the 50-82 neutron shell. Following standard prescriptions a comparative analysis of the data from the five reactions ^{A}Te(d,p)^{A+1}Te, A = 122, 124, 126, 128, 130 was performed and pairing model parameters were extracted. The

obtained information indicates that the constant pairing strength approximation is reasonable for the 50-82 neutron orbits in tellurium nuclei. (NL)

24822 POSSIBLE ROTATIONAL STATES IN ODD In NUCLEI. Dietrich, W.; Baecklin, A.; Lannergaard, C. O. (Uppsala Univ. (Sweden). Fysiska Institutionen); Ragnarsson, I. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., A; 253: No. 2, 429-447(24 Nov 1975).

Levels and transitions in ^{107}In and ^{109}In have been studied in in-beam spectroscopy on the reactions ^{106}Cd(d,nγ)^{107}In and ^{108}Cd(d,nγ)^{109}In. Low-lying $1/2^+$ and $3/2^+$ states resembling the possible rotational bands observed in the heavier In isotopes are seen in both nuclei. The potential energy has been calculated for $^{107-121}$In with the odd proton in different orbitals, using the Strutinsky normalization procedure. A prolate minimum at a deformation ≈0.2 is obtained for the lowest $1/2^+$ orbital, which is in good agreement with the experimental data for $^{115-119}$In. The excitation energy of the $1/2^+$ minimum shows a fairly good agreement with experimental data. (NL)

24823 PAIR PRODUCTION IN TIN AND NUCLEAR STRUCTURE STUDIES OF ^{208}Pb. Blankenship, S. M. Columbia, SC; Univ. of South Carolina (1975). 97p. University Microfilms Order No. 75-28,961.

Thesis (Ph. D.).

A new technique for measuring absolute pair production cross-sections for low energy gamma rays has been developed and applied to a pure tin target. The method consists of placing a small spherical radioactive source at the center of a spherical target and observing coincident annihilation radiation gamma rays subsequent to the creating of electron-positron pairs. Monte Carlo computer calculations were used to correct the raw data for scattering and absorption of annihilation radiation within the target, and for the creation of pairs by scattered incident gamma rays. A correction was made for the escape of positrons from the target. The resulting cross-sections as a function of energy in MeV were sigma(1.12) equals 5.4 +- 0.5, sigma(1.17 +- 1.33) equals 42 +- 4, sigma(1.33) equals 65 +- 3, sigma(1.84) equals 419 +- 20, and sigma(2.61) equals 1090 +- 50 mb. The comparison of these results to recent exact, unscreened theoretical calculations shows that, for Z equals 50, there is a sharp disagreement with the present experimental results below 1.3 MeV. While screening corrections result in cross-sections which are in better agreement, a discrepancy remains which indicates that the calculated screening correction is not adequate to explain measured pair production cross-sections. Directional correlations were measured for five gamma ray cascades in ^{208}Pb. These data allow a spin assignment of 4 to be made to the 3.961 MeV level. The multipole mixing ratios for five transitions were determined. (Diss. Abstr. Int., B)

24824 STUDY OF THE TWO-STEP PROCESSES IN THE (d,p) REACTION ON RARE-EARTH NUCLEI. Jaskola, M. (Institute of Nuclear Research, Warsaw (Poland)); Kozlowski, M. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Acta Phys. Pol., Ser. B; 4: 145-150(1973).

The two-step model of the (d,p) reaction in rare-earth nuclei is investigated. The inclusion of nonelastic scattering in the entrance and exit channels improves the agreement between the calculated values and experimental data, but the discrepancies in the absolute strengths remain. (auth)

24825 NUCLEAR INERTIAL MASS PARAMETER FOR DIFFERENT FORMS OF THE QUADRUPOLE FORCES. Stepien-Rudzka, W. (Institute of Nuclear Research, Warsaw (Poland)). Acta Phys. Pol., Ser. B; 4: 65-73(1973).

The inertial mass parameter B for collective oscillations of the quadrupole types is calculated. The quadrupole forces are taken in the form $Q = F(r)Y_{20}(\Omega)$, where F(r) assumes three different functional forms. Numerical calculations are performed in the rare-earth region. (auth)

24826 A NEW ISOMERIC STATE IN ^{134}Pr AND EXCITED STATES OF ^{134}Ce. Arlt, R.; Beyer, G.; Fominykh, V.; Herrmann, E.; Jasinski, A.; Ortlepp, H. G.; Strusny, H.; Tyrroff, H.; Usmanova, Z. (Joint Inst. for Nuclear Research, Dubna, (USSR)). Acta Phys. Pol., Ser. B; 4: 301-310(1973).

Radioactive sources of ^{134}Pr and ^{134}Nd in equilibrium with the ^{134}Pr daughter obtained by spallation reaction have been studied with Ge(Li) detectors. A new isomeric state has been found in ^{134}Pr. Gamma-gamma coincidences have been measured using two 25 cm^3 Ge(Li) detectors. On the basis of gamma intensities, energy sums, and coincidences information decay schemes are proposed for the isomeric and ground state of ^{134}Pr. (auth)

24827 INVESTIGATION OF THE ^{126}Ba → ^{126}Cs → ^{126}Xe DECAY. Blinowska, K. J.; Chojnacki, S.; Droste, Ch.; Morek, T.; Srebrny, J. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Acta Phys. Pol., Ser. B; 4: 75-80(1973).

The neutron deficient ^{126}Ba isotope was produced in the ^{118}Sn(^{12}C, 4n)^{126}Ba reaction at carbon ions energy E = 72 MeV. The decays of $^{126}_{56}$Ba → $^{126}_{55}$Cs → $^{126}_{54}$Xe and ^{126}Cs → ^{126}Xe were investigated by means of Ge(Li) detectors. The ^{126}Ba → ^{126}Cs decay scheme is presented. (auth)

24828 NUCLEAR ORIENTATION OF ^{95,97}Nb AND ^{95}Zr IN $ZrFe_2$. Krane, K.S. (Oregon State University, Corvallis, Oregon 97331); Olsen, C.E.; Rosenblum, S.S.; Steyert, W.A. Phys. Rev. C 13: No. 2, 831-834 (Feb 1976).

The angular distribution anisotropies of γ rays were measured following the decays of ^{95,97}Nb and ^{95}Zr oriented at low temperatures in the ferromagnetic Laves phase compound $ZrFe_2$. The magnetic hyperfine field of Nb in $ZrFe_2$ was deduced to be 9.4±1.6 T; that of Zr in $ZrFe_2$ was estimated to be 15±4 T. The nuclear magnetic moment of ^{97}Nb was deduced to be $|\mu| = (7.5 \pm 1.4)\ \mu_N$. (auth)

24829 SEMICLASSICAL AND QUANTUM MECHANICAL ASPECTS OF ONE- AND TWO-NUCLEON TRANSFER. Scott, D.K.; Hendrie, D.L.; Kraus, L.; Maguire, C.F.; Mahoney, J.; Terrien, Y.; Yagi, K. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 36: No. 4, 226-229 (26 Jan 1976).

A criterion for semiclassical or quantum-mechanical behavior in heavy-ion reactions is derived in terms of the number of contributing partial waves. The predictions are compared with one- and two-nucleon transfer reactions induced by 78-MeV ^{12}C ions on ^{144}Nd. (auth)

24830 LEVELS IN THE THREE-HOLE NUCLEUS ^{105}Ag AND THE DECAY OF 55.5-min ^{105}Cd. Jackson, S.V. (Lawrence Livermore Laboratory, Livermore, California 94550); Walters, W.B.; Meyer, R.A. Phys. Rev. C 13: No. 2, 803-830 (Feb 1976).

The γ-ray spectrum following the decay of 55.5-min ^{105}Cd to levels of ^{105}Ag has been studied by singles, coincidence, and Compton-suppressed γ-ray spectroscopy. Sources were prepared by the $(n,2n)$ reaction on isotopically enriched ^{106}Cd sources using 14-MeV neutrons. A total of 274 γ rays are attributed to the decay of ^{105}Ag, and ~248 are placed in a level scheme involving 53 excited states. These data along with the results of $(^3He,d)$ and (p,t) reaction studies were utilized to make spin and parity assignments for many of the levels. The systematics of the Z=47 silver nuclides are compared with various theoretical calculations and the systematics among the N=58 isotones are discussed. (auth)

24831 FAILURE OF BOHR'S COMPOUND NUCLEUS HYPOTHESIS FOR THE ^{98}Mo$(n,\gamma)^{99}$Mo REACTION. Chrien, R.E.; Cole, G.W. (Brookhaven National Laboratory, Upton, New York 11973); Slaughter, G.G.; Harvey, J.A. Phys. Rev. C 13: No. 2, 578-594 (Feb 1976).

Some remarkable features in the radiative deexcitation of narrow resonant states formed by slow neutron capture in ^{98}Mo are pointed out. Earlier investigations indicating strong correlations between radiative widths and the single particle widths of both initial and final states involved in the reaction have been extended. A more precise set of resonance neutron widths has been developed from new total cross section measurements on isotopically separated molybdenum. From high resolution Ge(Li) detector measurements, a more complete set of γ-ray transition intensities was derived. The resulting intensities are compared with intensities calculated from the valence neutron transition model of Lynn, with dipole matrix elements calculated from the ABACUS code of Auerbach. We conclude that the valence model works surprisingly well for ground state transitions from resonances with reduced widths of larger than about 10^{-3} single particle units. For smaller resonances, correlations persist, but these must be accounted for by other mechanisms. (auth)

24832 LOW-LYING LEVELS OF ^{94}Nb. Hagen, E.C.; Kern, B.D.; Snyder, F.D.; Miracle, D.E. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). Phys. Rev. C 13: No. 2, 620-625 (Feb 1976).

The low-lying low-spin levels of ^{94}Nb have been investigated; these levels were populated via the ^{94}Zr$(p,n\gamma)^{94}$Nb reaction with a separated isotope ^{94}Zr foil target (96% ^{94}Zr). Excitation functions of γ rays were obtained at incident proton energies from 1.688 to 3.700 MeV. γ-γ coincidences were observed at E_p=3.0 MeV. The existence of additional levels at 301.5, 450.3, 666.2, and 785.0 keV has been established. Computed Hauser-Feshbach (p,n) cross sections have been fitted to experimental cross sections deduced from the γ-ray data with the resulting best-fit spin-parities: 140.4-keV level, 2^-; 301.5, 2^-; 334.2, 3^+; 396.3, 4^-; and 450.3, 3^+. (auth)

24833 EFFECT OF INELASTIC COUPLING ON 0^+ ANALOG TRANSITIONS. Madsen, V.A.; Brown, V.R.; Grimes, S.M.; Poppe, C.H.; Anderson, J.D.; Davis, J.C.; Wong, C. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. C 13: No. 2, 548-555 (Feb 1976).

A comparison is made between experimental cross sections for the (p,n) reaction to the ground-state analogs of the isotopes ^{92}Mo, ^{98}Mo, ^{100}Mo, and coupled-channel calculations including coupling to the 2^+ and 3^- inelastic states and their analogs. When the coupling is included, very good fits are obtained for the (p,n) 0^+ analog differential cross section using uniform optical parameters for all three isotopes. Experimentally observed variations of about 50% in $\sigma/(N-Z)$, which in distorted-wave Born approximation changes by only 10%, are explained by the coupling. A crude third-order distorted-wave Born approximation model is developed which shows that the three-step amplitudes $0^+ \rightarrow 2^+ \rightarrow 2^+$ analog $\rightarrow 0^+$ analog, $0^+ \rightarrow 2^+ \rightarrow 0^+ \rightarrow 0^+$ analog, and $0^+ \rightarrow 0^+$ analog $\rightarrow 2^+$ analog $\rightarrow 0^+$ analog are all in phase and are destructive to the dominant one-step $0^+ \rightarrow 0^+$ analog amplitude. (auth)

24834 SPIN OF THE 1248- AND 1958-keV LEVELS IN ^{124}Te DETERMINED FROM GAMMA-GAMMA DIRECTIONAL AND POLARIZATION-DIRECTIONAL CORRELATIONS. Behar, M.; García Bermúdez, G.; Filevich, A.; Cambiaggio, M.C. (Departamento Física Nuclear, Comisión Nacional de Energía Atómica, Av. Libertador 8250, Buenos Aires, Argentina). Phys. Rev. C 13: No. 2, 767-770 (Feb 1976).

Directional correlations and polarization-directional correlations have been measured for the 646-603-keV and 709-646-keV cascades in ^{124}Te populated from the decay of ^{124}Sb. Ge(Li) detectors were used in both spectrometers, one of them, a planar Ge(Li) detector as the linear-polarization analyzer for the γ radiation. Combination of the results of these measurements gives unique spin assignments of 4^+ for the 1248-keV and 1958-keV levels. The determined $E2/M1$ mixing ratios are: δ (646) $=0.00\pm0.01$ and δ (709) $=0.02\ ^{+0.06}_{-0.07}$. (auth)

24835 TOTAL SPIN MEASUREMENT OF PROTON HOLE STATES BY THE (t, α) REACTION. Flynn, E.R.; Hardekopf, R.A.; Sherman, J.D.; Sunier, J.W. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545); Coffin, J.P. Phys. Rev. Lett. 36: No. 2, 79-81 (12 Jan 1976).

It is shown that it is possible to measure the total angular momentum of proton hole states by means of the (t, α) reaction using a recently developed polarized triton source. The reactions ^{90}Zr$(t, \alpha)^{89}$Y and ^{208}Pb$(t, \alpha)^{207}$Tl have been studied at 17-MeV bombarding energies and show large differences in the analyzing powers between spin-orbit partners $p_{1/2}$ and $p_{3/2}$ in the former case and $d_{3/2}$ and $d_{5/2}$ in the latter case. It is concluded that measurement of asymmetries in (t, α) reactions is a powerful technique to assign both l and j transfer for proton-pickup reactions. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 24714, 24753, 24805, 24811, 24814, 24815, 24824, 24825, 24860, 24862, 24864, and 24888.

24836 (ISN-75-10) STUDY OF THE ^{176}Lu(n,γ)^{177}Lu REACTION USING A γ BAND-FILTER SPECTROMETER. Geinos, D.; Kern, J.; Piependring, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). [nd]. 33p. Dep. NTIS (US Sales Only) $4.00.

The γ-ray spectrum from the ^{176}Lu(n,γ)^{177}Lu reaction has been investigated in the energy range of 450 to 1420 keV using a newly developed γ band-filter spectrometer. A total of 153 transitions have been observed. Improvements to the ^{177}Lu scheme are suggested, in particular the γ decay of several levels of the $\frac{1}{2}^-$ [530↑] and $\frac{3}{2}^-$ [532↓] rotational bands is proposed. Special attention has been given to the Coriolis coupling between the two latter bands and the $\frac{1}{2}^-$ [541↓] band. Results on a complementary investigation of the ^{176}Lu(n,γ)^{176}Lu reaction are presented. (auth)

24837 (UCRL-Trans-10753) NUCLEAR STATES IN ^{186}Re EXCITED BY THE (n,gamma) REACTION. Glatz, J. Translated from Z. Phys.; 265: 335-364(1973). 41p. Dep. NTIS $4.00.

Prompt and delayed gamma-gamma-coincidences were measured after slow neutron capture in ^{185}Re by the use of Ge(Li)-detectors. New isomers were found at 99,4 keV (Y/sub $\frac{1}{2}$/ equals 27 ← 7 nsec) and at approximately 330 keV (T/sub $\frac{1}{2}$/ equals 17.4 ← 0.7 nsec). Evaluation of the coincidence data established 10 rotational bands with band heads below 700 keV. The level scheme is discussed in detail: Nilsson assignments are proposed for the band configurations, and calculations of Coriolis mixing and gamma-transition probabilities are presented which reproduce the experimental level energies and transition intensities very satisfactorily. 9 tables, 8 figures. (auth)

24838 SELF-CONSISTENT PAIRING CALCULATIONS. Gogny, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). pp 333-352 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

After first describing briefly the Hartree-Fock Bogoliubov (H.F.B.) theory with interactions which depend on the density, a part of this report is devoted to the derivation of the so-called D1 effective force. There, this density dependent force of non-zero range is determined with the purpose of including the pairing correlations in the framework of the H.F.B. theory. Then a series of H.F.B. calculations on spherical and deformed nuclei is presented. It is seen that such calculations reproduce fairly well a great variety of nuclear properties. In particular, it appears that the force D1 not only provides a very good description of the average field but also reproduces remarkably well the fine details associated with the pairing field. Furthermore, preliminary results are given of a constrained H.F.B. calculation on deformed properties of the isotopes ^{148,150,152,154}Samarium. Finally the possibility of going beyond H.F.B. application is considered. It is found that a simple effective force of this type should permit one to extend these applications to problems in nuclear spectroscopy. (NL)

24839 INVESTIGATION OF "BACK BENDING" IN Yb NUCLEI. Dalafi, H. R. (Teheran Univ. (Iran)). pp 75-77 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Starting from the cranking model (first approximation to an angular momentum projection) and applying Hartree-Fock-Bogoliubov theory (HFB) one may give a satisfactory description of many properties of rotational bands in nuclei. Within the framework of this model and inclusion of approximate projection of particle number, the energy spectra of the ground state rotational bands of Yb isotopes have been studied with the aim of investigating the "back bending" effect in these nuclei. (NL)

24840 SELF-CONSISTENT NUCLEAR FIELDS AT HIGH SPINS. Mang, H. J. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). pp 47-62 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The cranking model is derived and applied to the study of phase transitions of nuclei at high angular momentum. (NL)

24841 SHAPE COEXISTENCE IN ^{187}Au. Deleplanque, M. A.; Gerschel, C.; Ishihara, M.; Perrin, N.; Berg, V.; Bourgeois, C.; Desthuilliers, M. G.; Husson, J. P.; Kilcher, P.; Letessier, J. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). J. Phys. (Paris), Lett.; 36: No. 9, L.205-L.208(Sep 1975). (In French)

^{187}Au was studied from ^{187}Hg decay and by the ^{175}Lu(^{16}O,4nγ)^{187}Au reaction at 95 MeV. The two decoupled bands built on h(9/2) and h(11/2) intrinsic states imply the coexistence of prolate and oblate deformations as in ^{189}Au. The behavior of high spin states is analyzed and compared to ^{186}Pt. (FR)

24842 g FACTOR OF THE 635.4 keV $\frac{7}{2}^+$ LEVEL IN ^{171}Tm. Patel, S. B.; Tandon, P. N.; Gopinathan, K. P. (Tata Inst. of Fundamental Research, Bombay). pp 20-21 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The 635.4 keV level in ^{171}Tm fed in the β decay of the 7.5 h ^{171}Er was recently identified unambiguously to be the $\frac{7}{2}^+$ [404] Nilsson state from directional correlation studies of γ rays through that level. The half-life of this level was measured to be 1.26 ± 0.06 nsec by delayed coincidence technique. Here we report the measurement of the g factor of this level using the perturbed angular correlation technique. The measurement was made using the 277.4 – 210.5 keV $\gamma-\gamma$ cascade in an externally applied magnetic field of 10.0 kG. The results are: $A_2 = 0.124 \pm 0.005$, $R = 0.047 \pm 0.007$, and $\omega\tau = 0.160 \pm 0.023$. Assuming Tm to be in the 3^+ ionic state after β decay of ^{171}Er, the g factor is obtained to be 0.36 ± 0.06. This value is in good agreement with the Nilsson estimate ($g = 0.41$) for this level. (auth)

24843 LEVEL STRUCTURE STUDIES IN ^{160}Dy. Bhati, S. S.; Singh, N.; Dass, P.; Trahan, P. N. (Panjab Univ., Chandigarh, India). pp 22-24 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Energy and intensity measurements of various γ rays in ^{160}Dy have been done using a Ge(Li) detector. In addition γ−γ angular correlation studies of ten cascades were done in ^{160}Dy using a Ge(Li)−NaI(Tl) fast coincidence set-up. These cascades are 299-966, 299-879, 197-87, 962-87, 879-87, 215-962, 299-(879)-87, 215-(962)-87, 299-(682)-197 and 215-(765)-197 keV. Out of these 215-(962)-87 and 215-(765)-87 keV cascades have been attempted for the first time. The multipolarities of 197, 215, 299, 879 and 962 keV γ rays were found to be E2 + (2 ± 2)%M3, E1 + (2 ± 2)%M2, E1 + (0.5 ± 0.5)%E2, M1 + (99.5 ± 0.5)%E2 and M1 + (98 ± 1)%E2 respectively. The reduced E1 and E2 transition probabilities of various transitions in ^{160}Dy have been compared with unified model calculations. This comparison shows that 1264 keV state belongs to K = 2 γ vibrational band, while 1286 and 1399 keV states are either K = 0 or K = 2 states and 1358 keV state is either K = 0 or K = 1 state. (auth)

24844 DECAY OF ^{187}W. Rao, K. S.; Ila, P.; Sudhakar, K.; Premchand, K.; Narasimham, K. L.; Lakshminarayana, V. (Andhra Univ., Waltair, India). pp 35-37 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The spectrum of γ rays accompanying 24 hour decay of ^{187}W has been investigated with a calibrated 35 cc Ge(Li) detector. From the estimated relative photon intensities and the recent conversion electron intensity data, conversion coefficients of eleven transitions in ^{187}Re have been deduced. In particular, the internal conversion penetration parameter of the hindered 35 keV transition was deduced from the present value of the conversion coefficient. The experimental results are presented and discussed with respect to spin-parity assignment of levels of ^{187}Re. (auth)

24845 γ−γ ANGULAR CORRELATION STUDIES IN ^{188}Os. Priyadarsini, D. K.; Sastry, B. R.; Seshagiri Rao, V.; Sastry, D. L. (Andhra Univ., Waltair, India). pp 38 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

γ−γ directional correlation measurements between the 931-155, 478-155, (825 + 829)-478 KeV Cascades involving the states 0^+, 2^+, 2^+, 0^+, 2^+, $(1^+, 2^+)$, 2^- in ^{188}Os were performed employing a Ge(Li)−NaI(Tl) system available with the Nuclear Spectroscopy group, TIFR, Bombay. The results on (478-155) KeV Cascade show a quadrupole content $Q_k \geq 0.99$ for the 478 KeV γ transition. The experimental coefficient for the 931-155 KeV Cascade are in accordance with the spin sequence 0^+-2^+-0^+. Finally the results are discussed. (auth)

24846 ELECTRIC QUADRUPOLE INTERACTION OF ^{177}Hf IN LUTETIUM COMPOUNDS STUDIED BY PERTURBED ANGULAR CORRELATION. Goninathan, K. P. (Reactor Research Centre, Kalpakkam, India). pp 48-50 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The γ−γ angular correlation of the 208.3−113 keV cascade in ^{177}Hf has been studied in solid lutetium compounds and in dilute solution of $LuCl_3$. A source of 6.8 d ^{177}Lu was used for the studies. From the measured attenuation factors for the solid compounds with respect to the liquid source, the coupling constants for quadrupole interaction were calculated. Taking the intrinsic quadrupole moment and the half-life from experimental results, the electric field gradients (EFG) at the Hf nuclei in the above solids have been deduced. (auth)

24847 INTERACTIONS OF ^{154}Gd NUCLEI WITH ITS ENVIRONMENT IN Cu-MATRIX BY PAC AND CHANNELING TECHNIQUES. Kurup, M. B.; Prasad, K. G.; Sharma, R. P. (Tata Inst. of Fundamental Research, Bombay). pp 51-53 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The Perturbed Angular Correlations (PAC) and channeling techniques have been combined to study the interaction of ^{154}Gd nuclei with their environment in diamagnetic Cu-host. Gd being an S state ion with half filled 4f shell (electronic configuration $8_{S_{\frac{7}{2}}}$) has l = 0. Consequently the 4f field vanishes and also the spin lattice interaction is absent. The field seen by the Gd nuclei is mainly due to the neighbouring ions depending on the location of Gd in Cu matrix and some possible polarisation effects of the 4f electrons. This special nature of Gd-ions has been used to investigate the field produced by neighboring ions due to non-substitutional sites and radiation damage. (auth)

24848 MICROSCOPIC APPROACH TO BACK-BENDING EFFECTS IN ^{158}Er AND ^{162}Er. Gunye, M. R. (Bhabha Atomic Research Center, Bombay); Warke, C. S. pp 147-149 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The recently observed high spin states in the rare-earth nuclei are studied in a self-consistent variational approach with the angular momentum projected Hartree-BCS wavefunctions. The nuclear Hamiltonian employed in the present work consists of the pairing plus quadrupole interactions. The nuclear deformation B, the neutron pairing gap Δ_n and the proton pairing gap Δ_p are varied to obtain the minimum energy for each angular momentum state. Our results rule out the suggestion of a phase transition from a superconducting to a normal state at the critical angular momentum $J \approx 12$. On the other hand, our results favor the interpretation of the back-bending effect in terms of a two-band theory. It should, however, be pointed out that the pairing gaps Δ_p and Δ_n decrease with the increase in angular momentum J. The calculated energy spectra in ^{158}Er and ^{162}Er are in good agreement with the recent experimental data. (auth)

24849 SHAPE MIXING IN ^{184,190}Hg. Baba, C. V. K. (Bhabha Atomic Research Center, Bombay). pp 221-223 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Recent potential energy calculations on even Hg isotopes have shown that ^{184,186}Hg are possibly deformed with two energy minima one each for oblate ($\beta_2 = -0.14$) and prolate ($\beta_2 = 0.28$) shapes. The quasi-rotational levels in these nuclei have been studied by heavy ion reactions at Berkeley and Chalk River. The salient features of these studies are (i) a deviation of the energy levels from a rotational sequence for $I \leq 6$; the levels with higher spins showing a good rotational spectrum and (ii) the deviation of the 4^+ goes to 2^+ and 2^+ goes to 0^+, E2 transition rates from the rotational value with $\beta_2 = 0.28$. These features of the spectra are explained on the basis of mixing of bands based on the oblate and prolate shapes. The results of a simple band mixing calculation are presented and they reproduce the observed level spacings and B(E2) values. (auth)

24850 DOUBLE CORIOLIS COUPLING IN ODD−ODD DEFORMED NUCLEI. Sharma, S. D.; Garg, V. P. (Punjabi Univ., Patiala, India). pp 230-232 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Double Coriolis coupling is expected to play an important role in the study of spectra, static moments and transition probabilities of odd−odd nuclei in bands with $K = 0^+$ and 1^+. Odd-even shift observed in case of these bands is expected to be useful to understand the nature of nuclear forces as only the tensorial forces are likely to explain the odd-even shift. As the first step, the effect of double coriolis coupling on the moments of inertia of deformed odd-odd nuclei is studied. The computed results are compared with the experimental reports. (auth)

24851 FURTHER MEASUREMENTS OF THE PROBABILITY OF α CLUSTER PRE-FORMATION BY MEANS OF (p,α) REACTIONS IN HEAVY ELEMENTS. Milazzo-Colli, L.; Braga-Marcazzan, G. M.; Milazzo, M. (Univ., Milan). Nuovo Cim., 30A: No. 4, 632-652(21 Dec 1975).

Energy spectra of α-particles emitted under bombardment of (20 to 30) MeV protons were studied in many nuclei of masses ranging from 150 to 210. It is found that the α-spectrum is mainly due to the pre-compound emission mechanism, except for the nuclei near lead, where a strong component of direct effect is found. As the pre-compound emission mechanism considered assumes the pre-formation of α-like clusters in the target nucleus, the reduction of this effect in nuclei near lead is attributed to a reduction of the α cluster pre-formation coefficient. In the frame of the pre-compound theory, the α cluster pre-formation coefficient is extracted from the absolute values of the reaction cross section and compared with other results. (auth)

24852 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{153}Gd. Alikov, B. A. (Samarkand State Univ., USSR); Budzinski, M.; Bedike, T. Acta Phys. Pol., Ser.; B7: No. 1, 59-68(Jan 1976). (In Russian)

The gamma–gamma angular correlations in the decay ^{153}Tb–^{153}Gd were studied employing Ge(Li)–Ge(Li) detectors. The A_2 and

A_4 coefficients were determined for the following cascades: 82.9–87.6, 82.9–19–109.7, 82.9–129.1, 102.2–68.2, 139.7–109.7, 174.3–87.6, 174.3–19–109.7, 102.2–109.7, 186.9–129.1, 193.7–109.7, 206.7 – 109.7, 332.5 – 109.7, 835.4 – 109.7, 845.6 – 109.7 and 991.7 – 109.7 keV. The mixing ratios of gamma-transitions 68.2, 87.6, 109.7 and 129.1 keV and the spins for 41.5($\frac{5}{2}$), 109.7($\frac{5}{2}$), 129.1($\frac{5}{2}$), 211.9($\frac{5}{2}$), 249.5($\frac{5}{2}$), 303.5($\frac{5}{2}$), 316.1($\frac{5}{2}$), 442.5($\frac{5}{2}$), 945.1 ($\frac{5}{2}$), 955.3($\frac{5}{2}$) and 1101.5($\frac{5}{2}$) keV states were deduced. The possible spin values of other states were also analyzed. (auth)

24853 THEORETICAL INVESTIGATIONS OF THE YRAST STATES OF EVEN ERBIUM ISOTOPES. Warke, C.S. (Tata Institute of Fundamental Research, Colaba, Bombay 5, India); Gunye, M.R. Phys. Rev. C 13: No. 2, 859-864 (Feb 1976).

An angular momentum projection formulation in conjunction with the many-body Nilsson-BCS variational wave function is presented for the pairing plus quadrupole interaction Hamiltonian. The theory is applied to calculate the energies and half-lives of the recently observed high spin yrast states in ^{156,158,160,162}Er and ^{156}Dy. The results of the calculation are in good agreement with the corresponding experimental data. (auth)

24854 PERTURBED BETA-GAMMA DIRECTIONAL CORRELATION IN ^{170}Tm DECAY. Tuli, J.K.; Emery, G.T. (Physics Department, Indiana University, Bloomington, Indiana 47401). Phys. Rev. C 13: No. 2, 799-802 (Feb 1976).

Measurements of the perturbed directional correlation for the $1^- \rightarrow 2^+ \rightarrow 0^+$ β-γ cascade in ^{170}Tm ground state decay have been performed with a fast-slow coincidence system using a time-to-pulse-height converter and a double-focusing magnetic spectrometer. A liquid source in the form of a solution in dilute HCl was used. The unattenuated A_2 coefficient was found to be -0.179 ± 0.018 for electrons of energy $W = 1.5\ mc^2$; this value, when combined with the attenuation rates observed in our samples, is consistent with most previously reported values for the time-integrated coefficient. (auth)

24855 EXCITATION OF SPIN-1 STATES IN ^{166,168,170}Er USING BREMSSTRAHLUNG. Metzger, F.R. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. C 13: No. 2, 626-630 (Feb 1976).

Some 40 states in ^{166,168,170}Er, most of them previously unknown, have been excited using bremsstrahlung with ≤ 4.2 MeV endpoint energy. For all but three of these levels, the angular distribution of the resonantly scattered radiation favors the assignment of spin 1. For some of the strongly excited levels, linear polarization measurements have been performed. They indicate that these levels have positive parity. The branching ratios further characterize them as $K = 1$ excitations. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 24685, 24688, 24714, 24725, 24769, 24773, 24784, 24805, 24810, 24814, 24823, 24835, 24851, 24888, and 24944.

24856 (KFK-2225) EXPERIMENTAL INVESTIGATIONS OF THE DIFFERENCES BETWEEN THE RADII OF PROTON AND NEUTRON DENSITY DISTRIBUTIONS OF ^{204,206,208}Pb AND STUDIES OF OCTUPOLE TRANSITION DENSITIES BY 104 MeV α-PARTICLE SCATTERING. Gils, H. J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Nov 1975. 80p. Dep. NTIS (US Sales Only) $5.00.

Differential cross sections of elastic and inelastic scattering of 104 MeV α-particles from ^{204,206,208}Pb have been measured with high angular accuracy. The angular distributions of the elastic scattering and of the inelastic scattering to the collective 3^--states at 2.63, 2.65 and 2.61 MeV excitation energy, respectively, have been analyzed in the framework of a semi-microscopic folding model. The analyses of elastic scattering treat the proton and neutron distributions independently. The proton distributions were taken from precise electron scattering results. The neutron distributions were parametrized by a modified Gaussian the parameters of which were varied in order to fit the experimental cross sections. The resulting rms-radii of the neutron distributions exceed the rms-radii of the proton distribution. The angular distributions of the 3^--states have been analyzed by the coupled channels method on the basis of a harmonic octupole vibrator model. From the resulting shape and size parameters isoscalar mass transition probabilities have been calculated. For the 3^--transition in ^{208}Pb differences between proton and neutron transition densities have been studied using theoretical densities and experimental form factors from electron scattering analyses. The investigations show that the theoretical densities which well reproduce the electromagnetic transition probability underestimate the neutron part of the transition density. The neutron transition density has been extracted. 9 tables, 21 figures. (auth)

24857 (LUNP-7504) PHOTOFISSION IN BISMUTH AT INTERMEDIATE ENERGY. Areskoug, M.; Schroeder, B.; Lindgren, K. (Lund Univ. (Sweden). Fysiska Institutionen; Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Kaernfysik). Apr 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

The yields of 43 fission products from photofission in ^{209}Bi induced by 600 MeV bremsstrahlung have been measured. From these values the mass and charge distributions have been determined. The peak position of the mass distribution is at $A_p = 96.3 \pm 0.5$ amu and the FWHM is 34.8 ± 0.7 amu. The ranges of 15 fission products have been determined using the thick-target thick-catcher technique and the kinetic energies have been deduced. Experimental results are compared with cascade-evaporation calculations in combination with liquid drop model calculations for the fission process. (7 figures, 3 tables) (auth)

24858 POTENTIAL ENERGY CURVES FROM THE STRUTINSKY PRESCRIPTION AND FROM A MICROSCOPIC APPROACH. Rao, Y. S. T.; Warke, C. S.; Mukhopadhyay, S. K. (Tata Inst. of Fundamental Research, Bombay). pp 82-84 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Potential energy curves are plotted for spherical to deformed shape transitions in samarium isotopes and for prolate to oblate transitions in ^{182}W, ^{190}Os, and ^{196}Pt. (SDF)

24859 ANOMALY IN THE NEUTRON CAPTURE CROSS-SECTION OF ^{197}Au AT 25 keV. Anand, R. P. (Bhabha Atomic Research Center, Bombay); Bhattacharya, D.; Kondaiah, E. pp 106 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The neutron capture cross-section of ^{198}Au at 25 keV, derived from shell transmission or activation methods, is frequently referred to as a standard. However the divergence between the published values of this cross-section is as much as a factor of two. In both of the above mentioned methods, self-shielding and multiple scattering corrections play an important role in the final evaluation of the cross-section. We have made a detailed study of the problem at (25 ± 5) keV neutron beam facility at the reactor APSARA,B.A.R.C. A stack of gold foils, with thin and thick foils alternately placed, was irradiated. The specific activity of the foils, when plotted against foil thickness, is found to fall sharply upto a thickness of 150 mgms/cm^2 but then remains flat right upto a thickness of 1700 mgm/cm^2. The thickness of the thin foils used by us was 50 mgm/cm^2. This sharp fall suggests that possibly there is some prominent resonance in the gold cross section at this energy. Recently Schneider has seen an intermediate structure in the total cross-section of gold around 23 keV. Using this intermediate structure we are now able to explain the anomaly to a good extent. (auth)

24860 QUASI-BOSON ASSUMPTION IN RARE EARTH AND SINGLE-CLOSED-SHELL NUCLEI. Peltier, S. M.; Plastino, A. (La Plata Univ. Nacional (Argentina)); Hernandez, E. S. (Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina)). pp 43-44 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Following the procedure of the QRPA formalism, the following have been studied: (i) γ, β and octupole vibrations in several even-even rare earth nuclei taking into account several shells, both for protons and neutrons; (ii) even single-closed shell (SCS) lead isotopes taking into account only the neutrons of the open shell; (iii) even SCS tin isotopes taking into account only the neutrons of the open shell. The results indicate that care should be taken in applying to QRPA to SCS nuclei. (NL)

24861 ASYMMETRIC ROTOR MODEL FOR DECOUPLED BANDS IN TRANSITIONAL ODD-MASS NUCLEI. Toki, H.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 253: No. 1, 231-252(17 Nov 1975).

The high-spin states in transitional odd-mass nuclei are studied in terms of an odd quasi-particle coupled to an asymmetric rotor with a variable moment of inertia (VMI). In order to take into account the VMI, the basis states are expanded in terms of the core eigenfunctions. Excitation energies, quadrupole moments, magnetic moments, B(E2) values and B(M1) values are calculated and

compared with the experimental data for nuclei in Au and La regions. On comparison with other descriptions it is found that the treatment with VMI provides a more satisfactory explanation of the data. (NL)

24862 REVIEW OF SOME RECENT RESULTS ON GROUND STATE DEFORMATION PROPERTIES OBTAINED IN SELF-CONSISTENT CALCULATIONS. Quentin, P. (Niels Bohr Institutet, Copenhagen (Denmark)). pp 297-329 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Recent results of various self-consistent calculations of deformed nuclei are reviewed. They are systematically compared with experimental data and available results from more phenomenological approaches using the Strutinsky method. Multipole moments and deformation parameters have been evaluated for deformed nuclei belonging to the s-d shell, the rare earth and the actinide regions. Single particle energies and wave functions are also presented. Finally, results obtained in the expected prolate-oblate shape transition region following the rare-earth nuclei (Os, Pt and Hg isotopes) are discussed. (NL)

24863 PHOTOFISSION CROSS SECTIONS OF ^{209}Bi, ^{232}Th, AND ^{238}U ABOVE 1 GeV. De Carvalho, H. G. (Centro Brasileirode Pesquisas Fisicas, Rio de Janeiro); Martins, J. B.; Tavares, O. A. P.; Di Napoli, V.; Terranova, M. L.; Tesch, K. Lett. Nuovo Cim.; 14: No. 17, C15-621(27 Dec 1975).

Some new data are given on the cross sections and fissilities for the photofission of bismuth-209, thorium-232, and uranium-238 at 1 to 5.5 GeV and 16 GeV for bismuth-209. (JFP)

24864 GREEN'S FUNCTION APPROACH TO PARTICLE–VIBRATION COUPLING. Baldo, M. (Univ., Catania, Italy); Bortignon, P. F. Lett. Nuovo Cim.; 14: No. 16, 587-591(20 Dec 1975).

The problem of separating correctly the particle and the phonon degrees of freedom in the attempts to introduce the phonon degree of freedom in the description of both single-particle structure and collective excitations of heavy and medium-heavy nuclei (particle-vibration coupling) is shown to be approached on general grounds in the framework of the conserving approximations. A particle coupled to a core is considered and the particle and phonon degrees of freedom are defined respectively by the single-particle and density–density correlation functions. (JFP)

24865 NUCLEAR INERTIAL MASS PARAMETER B IN THE ADIABATIC APPROXIMATION. Stepien-Rudzka, W. (Institute of Nuclear Research, Warsaw (Poland)). Acta Phys. Pol., Ser. B; 4: 467-487(1973).

The nuclear inertial mass parameter B is investigated by means of two slightly different approaches, both making use of the adiabatic approximation for the collective motion. The numerical results are given for two regions: the superheavy nuclei $108 \leq Z \leq 124$, $172Z \leq N \leq 188$ and the neutron-rich nuclei $88 \leq Z \leq 104$, $172 \leq N \leq 194$. The influence of the choice of the Nilsson model parameters κ and μ is investigated together with the dependence on the deformation parameters ϵ and ϵ_4. (auth)

24866 CHARGE DISTRIBUTION OF ^{208}Pb AND THE DIFFERENCE IN $\rho(r)$ FOR Pb and Tl INVESTIGATED BY ELASTIC ELECTRON SCATTERING. Euteneuer, H.; Friedrich, J.; Voegler, N. (Institut für Kernphysik der Johannes Gutenberg Universität, 65 Mainz, Federal Republic of Germany). Phys. Rev. Lett. 36: No. 3, 129-132 (19 Jan 1976).

Elastic electron-scattering cross sections from ^{208}Pb have been measured for 0.5 fm^{-1} $< q <$ 2.24 fm^{-1}. The charge distribution for this nucleus is determined by a "model-independent" method; it exhibits a bump in the center of the nucleus which is also a characteristic feature of Hartree-Fock calculations. The influence of the 3s protons on $\rho(r)$ has been investigated by a difference measurement between lead and thallium isotones. (auth)

24867 YIELDS OF ^{203}Pb IN THE IRRADIATION OF THALLIUM BY PROTONS AND DEUTERONS. Dmitriev, P. P.; Dmitrieva, Z. P.; Krasnov, N. N.; Molin, G. A.; Panarin, M. V. Sov. At. Energy (Engl. Transl.); 38: No. 2, 128-129(Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 100-101(Feb 1975).

Measurements were made of dependences of the yield of ^{203}Pb on the energy of the bombarding particles in the irradiation of six targets of metallic thallium with protons and deuterons. The literature contains no data on the yields and cross sections of reactions with the formation of ^{203}Pb. In the case of proton irradiation, ^{203}Pb is formed according to the reactions ^{203}Tl(p,n) and ^{205}Tl(p,3n); the energy thresholds of the reactions are equal to 1.61 and 15.9 MeV, respectively. In the case of deuteron irradiation, the reactions of formation of ^{203}Pb are ^{203}Tl(d,2n) and ^{205}Tl(d,4n) with energy thresholds of 3.87 and 18.2 MeV, respectively. The yield of the latter reaction is small when a deuteron energy of 22 MeV is used, in view of the high threshold. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 22729, 24769, 24863–24865, and 25120.

24868 (CEA-N-1821) MULTIGROUP FISSION AND CAPTURE CROSS SECTIONS OF /sup 242m/Am. Tellier, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). Sep 1975. 25p. (In French). Dep. NTIS (US Sales Only) $3.50.

For the physics of high burn up fuels and the plutonium recycle it is necessary to introduce the transplutonian nuclei in the reactor computation code. Because no evaluation of ^{242m}Am is today available in the neutron data files, we have estimated the fission and capture cross sections of this nucleus. For this purpose we have used in the thermal range the experimental values of the resolved resonance parameters, in the fast range the average cross section for the fission and a statistical model for the capture. This model is normalized on experimental fission data by adjustment of the transition levels scheme. It was not necessary to use a double humped fission barrier. Results are given in multigroup form for thermal reactors study. 6 figures, 5 tables. (auth)

24869 APPROXIMATE CALCULATION OF THE FISSION MASS PARAMETER OF PLUTONIUM–240. Flocard, H.; Vautherin, D. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). pp 35-36 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A simple expression for the mass parameter of quadrupole vibrations is obtained. It's predictions in the case of ^{240}Pu are looked at using constrained Hartree-Fock results with the Skyrme interaction. (NL)

24870 TIME DISTRIBUTION OF γ-RAYS FROM SPONTANEOUS FISSION OF ^{252}Cf AT SHORT TIMES. Skarsvaag, K. (Institutt for Atomenergi, Kjeller (Norway)). Nucl. Phys., A; 253: No. 2, 274-288(24 Nov 1975).

The gross time distribution of γ-rays from spontaneous fission of ^{252}Cf has been measured in the time range 10^{-11}–10^{-10}s after fission for γ-ray energies greater than 0.15 MeV. The measurements have been made by a new method based upon the solid angle aberration. From the measured correlation between half-lives and γ-ray transition energies it is concluded that the transitions are predominantly E2, single-particle transitions at high energies, and mostly vibrational and rotational transitions at lower energies. Some contribution of E1 transitions and M1-E2 mixtures cannot be excluded, however. It was found that about 30% of the γ-rays emitted within 12ns with energies greater than 0.10 MeV have half-lives shorter than 1 ps and about 52% half-lives between 1 and 100 ps. The relative yield of γ-rays and γ-ray energy in the time range 10^{-11} to 1.2×10^{-7}s after fission is given. (NL)

24871 DEPENDENCE OF ν-BAR ON NEUTRON ENERGY IN THE RANGE UP TO 5 MeV. Nurpeisov, B.; Volodin, K. E.; Nesterov, V. G.; Prokhorova, L. I.; Smirenkin, G. N.; Turchin, Yu. M. At. Energ. (USSR); 39: No. 3, 199-205(Sep 1975). (In Russian)

The dependence of the average yield of ^{233}U, ^{238}U and ^{239}Pu prompt fission neutrons on the energy of incident neutrons in the range up to 5 MeV has been investigated on an electrostatic generator. An installation permitting simultaneous measurement of neutron yield per fission event for the three investigated isotopes and a ^{252}Cf standard was used. (7 figures, 3 tables, 20 references) (auth)

24872 EVALUATION OF FISSION WIDTH OF 1^+ SPIN STATE AND UPDATING OF INTERMEDIATE RESONANCE PARAMETERS BASED ON DOUBLE HUMPED FISSION BARRIER MODEL FOR ^{239}Pu. Ganesan, S. (Reactor Research Center, Kalpakkam, India). pp 89-91 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

An accurate knowledge of fission width of $J = 1^+$ spin state is important and attractive for many reasons. After reviewing

the theoretical and experimental work done earlier, on the analysis of intermediate structure in the fission cross section of ^{239}Pu and specially the generation of intermediate resonance parameters based on Weigmann's formulation of Strutinsky's double-humped fission barrier model, we point out the need for updating the intermediate resonance parameters as any other basic neutron nuclear data is updated. Starting from the latest recommended values of the ratio of capture to fission cross sections for ^{239}Pu, we evaluate by adjustment, a set of fission width values for 1^+ spin state corresponding to the observed variations in α values. Using these values of fission widths we obtain a set of 37 intermediate resonance parameters using whichever can generate reliable widths of 1^+ spin state for any energy region below 10 KeV. (auth)

24873 ODD–EVEN Z EFFECTS IN THE TOTAL ENERGY RELEASE IN FISSION ANGULAR DISTRIBUTION OF FISSION FRAGMENTS. Walsh, R. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Boldeman, J. W.; Caruana, J.; Mathur, J. N. pp 92-95 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Fission into two evenly charged fragments liberates on average 2.5 MeV more energy than fission into two oddly charged fragments. An experimental investigation has been made to determine whether this excess energy passes into fragment excitation energy, and hence neutron emission, or into fragment kinetic energy, using a ^{252}Cf spontaneous fission source. In the same experiment the variation of fragment neutron emission with fragment mass and total kinetic energy has been obtained. A multiparameter detection system was used, involving two surface barrier fragment detectors, together with a high resistivity silicon x-ray detector to determine the fragment charge Z. Present experimental accuracy is not sufficient to confirm or deny an odd-even Z effect in the total neutron emission. A value of 0.15 ± 0.25 neutrons has been obtained, which is smaller than that expected by a factor of two. The variation of total neutron emission with fragment mass, however, shows fine structure which correlates excellently with the positions of the fine structure peaks of the ^{252}Cf mass yield curve. (auth)

24874 α PARTICLE TRAJECTORY CALCULATIONS IN SPONTANEOUS TERNARY FISSION OF ^{252}Cf AND STUDIES OF SCISSION POINT CONFIGURATIONS. Choudhury, R. K.; Ramamurthy, V. S. (Bhabha Atomic Research Center, Bombay). pp 134-136 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Three-point-charge model trajectory calculations have been carried out to search for possible scission configurations in spontaneous ternary fission of ^{252}Cf. The distribution of fragment kinetic energies and α particle energies for various mass divisions were used as input. Three parameters were used to specify the scission configuration: the interfragment distance D, the distance of the α particle from the heavy fragment X, and the distance of the α particle from the fission axis Y. As different from similar earlier investigations, for each mass division, not only the most probable values of the parameters O, X and Y but also their variances have been obtained. It is shown that with these parameters as input, it is possible to explain most of the experimentally observed energy and angular correlations. An important conclusion arising out of the present investigations is that the α particles originate nearer to either one of the fragments. Possible experimental confirmation of this conclusion is also discussed. (auth)

24875 α PARTICLE TRAJECTORY CALCULATIONS IN SPONTANEOUS QUARTERNARY FISSION OF ^{252}Cf. Kateria, S. K. (Bhabha Atomic Research Center, Bombay). pp 137-139 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The trajectory calculations have been performed in an attempt to explain the energy and angular correlations between the two light charged particles (LCP) emitted in the spontaneous fission of ^{252}Cf. Three possible emission mechanisms and scission configurations for LCP have been tested with trajectory calculations and compared with the observed energy and angular correlations. The first hypothesis is that the two LCP are the result of breakup of ^{8}Ba. The second hypothesis is that the two LCP are produced in between the fragments near the axis of separation, simultaneously. The last hypothesis tested is that the two LCP are being emitted from the two fragments independent of each other. Only the last hypothesis predicts angular and energy correlation in agreement with the experimental results. From trajectory calculations for quaternary fission, many important conclusions have been reached regarding the emission mechanism of LCP. (auth)

24876 THREE DIMENSIONAL CORRELATIONS OF FRAGMENT MASS, FRAGMENT ENERGY, AND LONG RANGE α PARTICLE ENERGY IN THE FISSION OF ^{235}U BY THERMAL NEUTRONS. Nadkarni, D. R.; Choudhury, R. K.; Furthy, S. R. S.; Rama Rao, P. N.; Kapoor, S. S. (Bhabha Atomic Research Center, Bombay). pp 140-143 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

To investigate in detail the various correlations between the energy and mass of fission fragments and LRA energy we have carried out a 3-parameter investigation in the thermal neutron fission of ^{235}U. A back-to-back gridded ionization chamber was used to measure the energies of correlated fragments and the energy of coincident LRA was measured with semiconductor detectors. This setup ensured that events recorded are not restricted to any particular angle between fragments and LRA but cover all the angles. The data have been analysed to obtain total coulomb energy distributions in binary and ternary fissions and these results are used to compare scission point configurations in binary and ternary cases. The average LRA energy was seen to decrease with asymmetry in mass division. One other new feature observed was the non-linear anticorrelation between E_k and E_α and the dependence of this anti-correlation on the mass asymmetry. With these data scission parameters in ternary fission are derived by carrying out trajectory calculations, and these results are discussed. (auth)

24877 SCATTERING OF NEUTRONS FROM PRINCIPAL FERTILE AND FISSILE NUCLEI. Satyanarayana, U.; Ramamurty, S.; Lakshmana Das, N. (Andhra Univ., Waltair, India). pp 193-195 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Elastic and inelastic scattering of neutrons from ^{232}Th, ^{235}U, ^{238}U and ^{239}Pu have been calculated using strong absorption model. A computer program has been developed to do these calculations on IBM 1130. The differential cross section for elastic scattering has been calculated with and without the strong absorption condition; and there is a difference of about 0.5 barns per sterdian which may be attributed to the simplifications made when strong absorption conditions are included in the calculations. The radius parameter is quite different from that used in optical model calculations. These matters are discussed in the paper. (auth)

24878 A STUDY OF THE γ RAY SPECTRUM OF ^{226}Ra IN EQUILIBRIUM WITH ITS DECAY PRODUCTS. Hachem, A. (Nice Univ., 06 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 1, 45–47(7 Jul 1975). (In French)

The energy and intensity of the γ transitions from the decay of ^{226}Ra in equilibrium with its products have been measured using high-resolution Ge(Li) detectors. 55 new gammas have been observed. (FR)

24879 TIME-OF-FLIGHT NEUTRON SPECTROSCOPY USING APPROXIMATELY 20 METER FLIGHT PATHS TO A NUCLEAR DEVICE. Forman, L.; Silbert, M. G.; Schelberg, A. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 128: No. 3, 607-608(15 Oct 1975).

Time-of-flight neutron spectroscopy is described using relativity short flight paths to nuclear explosives. Neutron fluxes have been determined from ^{235}U and ^{232}U fission with solid state detectors in the direct current mode. A demonstration gamma-ray production cross section experiment for ^{241}Am has yielded data over the neutron energy range 0.3–6.0 MeV. (NL)

24880 WESCOTT g_f-FACTOR AS A FUNCTION OF THE TEMPERATURE FOR ^{241}Pu. Wagemans, C.; Deruytter, A. J. (CEN, Mol, Belgium). Ann. Nucl. Energy; 2: No. 7/8, 541-544 (Aug 1975).

The Wescott g_f-factor, which is important for the physics of thermal reactors, was calculated using recent accurate neutron induced fission cross-section data for ^{241}Pu. It yielded $g_f(20.44°C) = 1.046 \pm 0.006$. The temperature dependence of g_f was also calculated in the temperature range 0° to 1000°C and compared with previous results. (auth)

24881 EVIDENCE FOR ROTATIONAL BANDS NEAR THE ^{232}Th(n, f) FISSION THRESHOLD. Blons, J.; Mazur, C.; Paya, D. (Département de Physique Nucléaire, Centre d'Etudes Nucléaires Saclay, 91190 Gif-sur-Yvette, France). Phys. Rev. Lett. 35: No. 26, 1749-1751 (29 Dec 1975).

The ^{232}Th(n, f) cross section and the angular anisotropy of fission fragments have been measured up to 5 MeV. The broad vibrational levels located above 1 MeV are resolved into sharp structures which are interpreted as rotational states. The rotational constants $\hbar^2/2\mathcal{J}$ of highly deformed ^{233}Th are found to be 2.46 and 2.73 keV at 1.5 and 1.6 MeV, respectively. Our results are interpreted in terms of a hypothetical third minimum in the fission barrier. (auth)

24882 ENERGY DEPENDENCE OF QUASIFISSION. Tamain, B.; Plasil, F.; Ngô, C.; Péter, J. (Chimie Nucléaire, Institut de Physique Nucléaire, 91406 Orsay, France); Berlanger, M.; Hanappe, F. Phys. Rev. Lett. 36: No. 1, 18-21 (5 Jan 1976).

Quasifission reactions induced by 443-MeV ^{63}Cu ions on ^{197}Au are studied and compared with results at 365 MeV. The initial relative motion is completely damped in both cases. At the higher energy, the angular distribution is broader and peaked further forward, and the complete-fusion component is larger. Near the grazing angle partially damped events are observed in addition to quasifission. (auth)

24883 MASS YIELD DISTRIBUTIONS IN THE REACTION OF ^{136}Xe IONS WITH ^{238}U. Otto, R.J.; Fowler, M.M.; Lee, D.; Seaborg, G.T. (Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). Phys. Rev. Lett. 36: No. 3, 135-138 (19 Jan 1976).

Yields of 131 nuclides were measured radiochemically to delineate the mass distribution in the reaction of 1150-MeV ^{136}Xe with a thick ^{238}U target. Six components attributed to either the quasifission or the quasielastic-transfer mechanisms were observed in the mass distribution. An upper limit of 20 mb is given for the fusion-fission process. Neutron-deficient product masses in the region $180 < A < 210$, colloquially referred to as the "gold finger," are explained as heavy quasifission products. (auth)

24884 COLLECTIVE STATES IN ^{233}U, ^{235}U, ^{237}Np, AND ^{239}Pu EXCITED BY INELASTIC DEUTERON SCATTERING. Thompson, R.C.; Huizenga, J.R. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627); Elze, Th.W. Phys. Rev. C 13: No. 2, 638-647 (Feb 1976).

Energy spectra of inelastically scattered 16-MeV deuterons were measured at angles of 90° and 125° using enriched targets of ^{233}U, ^{235}U, ^{237}Np, and ^{239}Pu. The octupole band resulting from the ground-state coupling to the $K^\pi=0^-$ octupole vibration of the core is identified in ^{233}U, ^{237}Np, and ^{239}Pu and is tentatively assigned in ^{235}U. Evidence for the observation of ground-state coupling to the higher lying octupole bands is discussed for ^{233}U, ^{237}Np, and ^{239}Pu. Comparison is made of the core vibrations of the odd-A nucleus with those observed in the adjacent even-even nuclei. The $K-2$ and $K+2$ γ bands built on the ground state of ^{235}U are seen. (auth)

24885 COLLECTIVE EXCITATIONS IN ^{246}Cm AND THE DECAY OF ^{246}Am^m. Multhauf, L.G.; Tirsell, K.G.; Meyer, R.A. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. C 13: No. 2, 771-789 (Feb 1976).

Intense sources of ^{246}Pu have been produced (through double neutron capture by ^{244}Pu) for making detailed electromagnetic and conversion-electron measurements of the decay of ^{246}Am^m to levels of ^{246}Cm. γ rays from ^{246}Pu decaying to ^{246}Am levels were identified in a chemical milking experiment. Of the 260 ^{246}Cm γ rays observed, 97 are new and 64 have been assigned multipolarities from Si (Li) conversion-electron measurements. Some transitions were found to have strong $E0$ components, and two pure $E0$ transitions were observed. High-resolution γ-γ-time coincidence measurements were used to establish 54 levels, from which the low-energy band structure of ^{246}Cm was determined. The investigation confirmed previous assignments of $K^\pi=0^-$, 1^-, and 2^- octupole bands, and a $K^\pi=0^+$ band at 1175 keV. We have also identified the probable $K^\pi=3^-$ octupole band, and a second $K^\pi=0^+$ band at 1289 keV. The two $K^\pi=0^+$ bands are discussed in terms of possible collective excitations. Other identified bands are discussed in terms of two-quasiparticle and multipole-phonon excitations. (auth)

24886 IDENTIFICATION OF ^{109}Tc AND ^{110}Tc IN FISSION OF ^{249}Cf. Trautmann, N.; Kaffrell, N.; Ahrens, H.; Dittner, P.F. (Institut für Kernchemie der Universität Mainz, D-65 Mainz, Germany). Phys. Rev. C 13: No. 2, 872-874 (Feb 1976).

The neutron-rich nuclides ^{109}Tc and ^{110}Tc, produced by thermal-neutron-induced fission of ^{249}Cf, have been identified using a fast automated chemical procedure for the separation of technetium from the fission product mixture. Half-lives of 1.4 ± 0.4 and 1.0 ± 0.2 sec for ^{109}Tc and ^{110}Tc, respectively, have been deduced from γ-ray spectra of the technetium fraction. (auth)

24887 ISOMER SHELLS IN THE CROSS SECTION OF DEEP SUBBARRIER PHOTOFISSION OF HEAVY NUCLEI. Zhuchko, V.E.; Ignatyuk, A.V.; Ostapenko, Yu.B.; Smirenkin, G.N.; Soldatov, A.S.; Tsipenyuk, Y.M. (Institute of Physics Problems, USSR Academy of Sciences). JETP Lett. 22: No. 4, 118-119 (20 Aug 1975).

For the isotopes ^{232}Th, ^{237}Np, and ^{238}U, in the deep subbarrier region, we observed an abrupt decrease of the slope of the energy dependence of the photofission cross section, called the isomer shelf. An investigation of this phenomenon uncovers a number of new possibilities for the refinement of our concepts concerning the structure of the fission barrier of heavy nuclei. (auth)

24888 PROSPECTS FOR THE PREPARATION OF SUPER-HEAVY NUCLEI IN FISSION REACTIONS. Flerov, G. N.; Oganesyan, Yu. Ts. Sov. Radiochem. (Engl. Transl.); 16: No. 5, 657-666(1974).

From symposium on the chemistry of transuranium elements; Moscow, USSR (4 Sep 1972). Translated from Radiokhimiya; 16: No. 5, 666-677(1974).

Numerous experiments carried out to study the process and the products of the interaction of the xenon nuclei with zinc, tantalum, bismuth, and uranium have demonstrated the validity of qualitative considerations of 1965-1971 on the efficiency of fission as a method of synthesizing superheavy nuclei ($z \simeq 114$, $N \simeq 184$). In the irradiation of uranium with xenon the probability of the formation of superheavy nuclei in the ground state must increase with an increase in the lifetime relative to spontaneous fission and correspond according to our estimates to $\sigma \sim 10^{-33}$ cm^2 for a half-life in the range of 1 day $\leq T \leq$ 100 day. With an increase in the sensitivity of the experiment by a factor of 10^2, which corresponds to $\sigma \sim 10^{-35}$ cm^2, it should be possible to observe superheavy nuclei over a wide range of lifetimes, atomic numbers, and mass numbers. In this case the nonobservation of spontaneous emitters would indicate the absence of a second region of stability of nuclei close to $Z \simeq 114$ and $N \simeq 184$. Experiments on the chemical isolation of the products from the nuclear reaction ^{238}U + ^{136}Xe indicated the presence of a spontaneous emitter (one or several), obtained with an effective cross section of $\sim 10^{-32}$-10^{-33} cm^2. These emitters are isolated together with the sulfides of such elements as thallium, lead, bismuth, etc. The half-life of the spontaneously fissile emitter observed is more than 50 days. Preliminary experiments to measure the number of secondary neutrons accompanying the fission of these nuclei do not make it possible to assign the observed effect unequivocally to spontaneous fission of superheavy elements. 8 figures. (auth)

24889 SECONDARY NEUTRON SPECTRA IN ^{235}U AND ^{239}Pu FISSION BY 0.1 MeV NEUTRONS. Aleksandrova, Z. A.; Bol'shov, V. I.; Kuznetsov, V. F.; Smirenkin, G. N.; Tarasko, M. Z. Sov. At. Energy (Engl. Transl.); 38: No. 2, 140-141(Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 108-109(Feb 1975).

Secondary fission neutron spectra from ^{235}U and ^{239}Pu were measured with a scintillation detector and stilbene crystal using γ ray pulse shape discrimination. The instrumental distribution was analyzed by the Lanczos differentiation and smoothing method and by the Burros method which takes into account the actual line shape corresponding to monochromatic neutrons. (SDF)

Nuclear Theory

Refer also to abstracts 24486, 24681, 24755, 24838, 24840, 24841, 24850, and 24877.

24890 (CEA-N-1805) CONTRIBUTION TO THE STUDY OF THE NEUTRON STRENGTH FUNCTIONS AND OF THE OPTICAL MODEL AT VERY LOW ENERGY. Delaroche, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de la Metrologie et de la Physique Neutroniques Fondamentales). Jun 1975. 106p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis.

In the low energy range, evidence for neutron absorption variations versus the A mass target number may be obtained from the determination of s and p wave neutron strength functions $S_0(A)$ and $S_1(A)$ which are simply connected to s and p wave components of the compound nucleus cross sections. Some works have been done as an attempt to explain S_0 and S_1 variations in term of optical potential calculations. Though coupled channel calculations were shown to be better than spherical claculations, the trend of variations was obtained, without any general satisfactory fits. In addition, it was not usually possible to produce a simultaneous agreement between measured and calculated values of $S_0(A)$ and $S_1(A)$ so that one may suspect the validity of optical model interpretation in the low energy region. In the present work, this study is continued with an improved version of the Tamura coupled channel code JUPITOR-1. So many experimental results, some of

which obtained at Saclay's 60 MeV LINAC, were interpreted in a satisfactory way: S_0 and S_1 and, for odd mass nucleus, possible variations with spin of compound nucleus. That was possible by including, in optical potential, a complex isospin-isospin term, and a real spin-spin term as suggested by Feshbach. For a given nucleus, we show also that it is possible to have a simultaneous fit for S_0 and S_1, using only one set of optical potential parameters. Results, such obtained from these calculations, suggest that neutron-nucleus optical potential parametrization might be similar in the low and in higher energy range. (11 figures, 8 tables) (auth)

24891 (COO-2171-55) COUPLED EQUATIONS METHOD FOR PION SCATTERING FROM THE TWO-NUCLEON SYSTEM. Mizutani, T. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Sep 1975. 273p. (UR-553). Dep. NTIS $9.00.

Thesis.

An attempt is made to clarify the structure of pion-nucleus scattering taking into account the fact that the pions in scattering and in nuclear forces are identical. To understand the essential points, a simple pion plus two-nucleon system is chosen. The processes considered are piNN yields piNN and piNN reversible NN. Both relativistic and nonrelativistic approaches are adopted. In the relativistic approach Taylor's method is used, whereas in the nonrelativistic approach a Hamiltonian (Schroedinger equation) method is utilized together with a projection technique. Both approaches give a finite set of amplitude equations respectively, and the formal correspondence between these sets of equations is observed. Due to the proper consideration of pions, the problem of pion overcounting does not occur and the amplitudes are shown to satisfy at least two- and three-particle unitarity. Through the study of the scattering in the piNN system, several important aspects common in general pion-nucleus scattering have been observed. For instance, this observation gives some new insight into the proper structure of pion-nucleus optical potentials. For practical applications the nonrelativistic piNN amplitudes are reduced in angular momentum-isospin eigenstates together with the inclusion of bound states. The reduced amplitudes are then used to study the pion absorption effect on the pion–deuteron scattering length. The result is consistent with experiment. Some possible future applications of the formulations developed are discussed. 10 tables, 2 figures, 65 references. (auth)

24892 (COO-3463-23) NEUTRON AND GAMMA EMISSION FROM HIGHLY EXCITED STATES AND STATES WITH HIGH SPIN. Annual Progress Report. Sperber, D. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Aug 1975. Contract E(11-1)-3463. 13p. Dep. NTIS $4.50.

During the last year attention was focused on the theoretical study of heavy ion induced reactions at low and intermediate energy with particular attention on very heavy projectiles. Most of the studies described have been finished, others are under current investigation. In most of the calculations, a classical dynamical approach was adopted, others concern themselves with assessing the validity of this classical approximation. In all calculations, one addressed oneself to the evaluation of quantities which are measured experimentally. Examples of such quantities are the critical angular momentum for complete fusion, the angular distribution for deep inelastic processes, and mass and energy transfer. The following topics have been investigated during the recent phase of this program: (1) The development of a classical dynamical model for the study of heavy ion reactions. (2) The calculation of the critical angular momentum using the proximity potential. (3) The role of potential and friction in heavy ion reactions. (4) Angular distribution for Kr induced reactions. (5) The validity of the sharp cut-off approximation. (6) The difference between Argon and Krypton induced reactions leading to the same compound nucleus. (7) Statistical studies of mass transfer. (8) The inclusion of the necking degree of freedom. (9) Semiclassical calculation. The results of the studies of the first seven topics are already available in the open literature. The last two topics are under current investigation. (auth)

24893 (IFA-CRD-60-1975) THREE NUMERICAL METHODS FOR THE COMPUTATION OF THE ELECTROSTATIC ENERGY. Poenaru, D. N.; Galeriu, D. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 20p. Dep. NTIS (US Sales Only) $3.50.

The FORTRAN programs for computation of the electrostatic energy of a body with axial symmetry by Lawrence, Hill-Wheeler and Beringer methods are presented in detail. The accuracy, time of computation and the required memory of these methods are tested at various deformations for two simple parametrizations: two overlapping identical spheres and a spheroid. On this basis the field of application of each method is recommended. (auth)

24894 (IFA-DNR-21-1975) CROSS SECTION CALCULATIONS BY THE COUPLED CHANNEL THEORY: A MODIFIED VERSION OF THE PROGRAM JUPITOR. Mateescu, S.; Badescu, E.; Dragan, N.; Pintiliescu, L. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 16p. Dep. NTIS (US Sales Only) $3.50.

The principles of the calculations by the coupled channel theory are presented. The particular steps of the cross sections, polarizations, and strength functions calculations by this theoretical model are given. Some modifications of the program JUPITOR are shown. The program and its characteristics are also described. In the last part of the paper, some output examples of the new version of the program are given. 3 figures, 2 tables. (auth)

24895 (IPNO/TH-75-11) NUCLEAR GROUND STATE PROPERTIES AND SELF-CONSISTENT CALCULATIONS WITH THE SKYRME INTERACTION. II. S-D Shell Nuclei. Flocard, H.; Quentin, P. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Apr 1975. 36p. Dep. NTIS (US Sales Only) $4.00.

Hartree-Fock results concerning the ground state properties of some S-D shell nuclei are presented and discussed. Two different Skyrme interactions have been used. They both lead to good agreement with the experimental total binding energies, charge radii and multipole moments. In particular the observed prolate-oblate transitions occurring in the S-D shell are reproduced. The calculated spectroscopic factors are also shown to be consistent with experimental data. 8 figures, 12 tables. (auth)

24896 (ISS-P-75/6) ELECTRON SCATTERING AND NUCLEAR INTERACTIONS. Ciofi degli Atti, C. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 14 Apr 1975. 22p. Dep. NTIS (US Sales Only) $3.50.

The possibility of obtaining information on nuclear interactions by means of high energy electron scattering is discussed. It is shown that there exist several difficulties in reconciling experimental data and theoretical models based on static realistic two-body forces and Brueckner Hartree Fock approximations. Some effects of exchange currents are discussed. 10 figures, 6 tables. (auth)

24897 (LBL-4316) APPLICATION OF GENERALIZED CLASSICAL TRAJECTORIES IN NUCLEAR PHYSICS. Leser, H. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-Eng-48. 194p. Dep. NTIS $7.50.

Thesis.

A new semi-classical method, the so-called uniform semiclassical approximation, is described briefly and then applied to two nuclear physics problems. The basic features of this method are that the dynamics of the problem is treated completely classically (that is, one solves classical equations of motion), but the quantum mechanical superposition principle is retained by evaluating a phase along the classical trajectory and adding probability amplitudes for indistinguishable processes rather than probabilities themselves. The first problem considered is the backscattering from a deformed nucleus and the excitation of rotational states in the target at energies up to the Coulomb barrier. The multiple Coulomb excitation calculations are in quantitative agreement with a very different method (the de Boer-Winther code). A nuclear optical potential is also considered and the nuclear-Coulomb interference for heavy ions is studied. The second problem considered is the tunneling through a two-dimensional barrier. This problem (which is supposed to simulate the penetration through a two-dimensional fission barrier) is investigated by a fully quantum-mechanical coupled-channel calculation and by the uniform semiclassical approximation. A quantitative agreement is found. (auth)

24898 (LBL-4342) LECTURES ON GEOMETRICAL PROPERTIES OF NUCLEI. Myers, W. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. 43p. (CONF-750848-2). Dep. NTIS $4.00.

From 8th summer school on nuclear physics; Mikotajki, Poland (24 Aug 1975).

Material concerning the geometrical properties of nuclei is drawn from a number of different sources. The leptodermous nature of nuclear density distributions and potential wells is used to draw together the various geometrical properties of these systems and to provide a unified means for their description. Extensive use is made of expansions of radial properties in terms of the surface diffuseness. A strong case is made for the use of convolution as a geometrical ansatz for generating diffuse surface distributions because of the number of simplifications that arise which are of practical importance. 7 figures. (auth)

24899 (LBL-4351) POLARIZATION PHENOMENA IN FEW-BODY SYSTEMS. Conzett, H. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-Eng-48. 12p. (CONF-751231-1). Dep. NTIS $3.50.

From 7th international conference on few-body problems in nuclear and particle physics; Delhi, India (29 Dec 1975).

Recent polarization studies in N–N scattering at and below 50 MeV have provided specific and significant improvements in the phase-shift parameters. High energy investigations with both polarized proton beams and targets have shown unexpectedly large spin effects, and this provides a challenge for theoretical effort to explain these results. Experimental and theoretical work on the three-nucleon problem continues to yield new and interesting results, with the emphasis now shifting to polarization studies in the breakup reaction. On-going work on several-nucleon systems continues to provide polarization data for general analyses, nuclear structure information, or specific resonance effects. Finally, the basic interaction symmetries continue to have unique and important consequences for polarization observables. 17 figures. (auth)

24900 (LF-63) SPIN DISTRIBUTION OF SPALLATION PRODUCTS YIELDS OF ISOMERIC STATES. Rudstam, G. (Forskningsraadens Lab., Studsvik (Sweden)). 1975. 39p. Dep. NTIS (US Sales Only) $4.00.

In the analysis of the evaporation step in spallation reactions, the spin distribution of the last few members of the chain is of decisive importance for the relative probabilities of forming different isomeric states of the final products. Therefore, a previous calculation has now been extended to include the spin distribution. The theoretical model used is described, and the computer program written for the calculation is outlined. The choice of parameters is discussed. Finally, some spallation yields including the yield ratio for the formation of the high-spin isomeric state and the low-spin ground state of zinc-69 have been calculated and are compared to experimental results. A more extensive test of the theory by comparing calculated and experimental fission and spallation yields is in progress. (auth)

24901 DYNAMICS OF NUCLEAR FLUID. I. FOUNDATION. Wong, C. Y.; Maruhn, J. A.; Welton, T. A. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Phys., A; 253: No. 2, 469-489(24 Nov 1975).

Starting with the time-dependent Hartree–Fock (TDHF) formulation of the many-body problem, the equation is cast into a set of conservation laws of classical type. Besides the equation of continuity, TDHF leads to an equation of motion which is analogous to the Euler equation in classical fluid dynamics. The forces do not come from the collective kinetic stress alone, but also from a density-dependent chemical potential, the surface tensional force which depends on density differences, and the Coulomb interaction. With an assumed Navier–Stokes generalization of the stress tensor, such a set of differential equations provides a powerful tool for the study of complicated collective motions of nuclear systems such as those involved in heavy-ion reactions and nuclear fission. In the static case, the equation of motion leads to the Thomas–Fermi model of a finite nucleus as formulated by Bethe. (NL)

24902 SEMICLASSICAL APPROXIMATION IN A REALISTIC ONE-BODY POTENTIAL. Jennings, B. K.; Bhaduri, R. K. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics); Brack, M. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 253: No. 1, 29-44(17 Nov 1975).

For a system of noninteracting fermions in a one-body potential including spin-orbit interaction, an explicit series in the expansion parameter $(\hbar/2\pi)^2$ is derived for the "smooth" part of the energy. The formalism is only valid for potentials with no discontinuous edges, and is based on the Wigner-Kirkwood semiclassical partition function. Some numerical calculations are done in realistic spherical and deformed potentials to demonstrate the practical utility of the method. Numerical comparisons with the corresponding Strutinsky calculations are also made. (NL)

24903 E2 CONVERSION COEFFICIENTS. Lakshminarayana, S.; Parthasardhi, K.; Seshagiri Rao, V. (Andhra Univ., Visakhapatnam, India). pp 8 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Most of the available E2 conversion coefficients by the Internal External Conversion (IEC) technique are corrected using the more accurate photo-electric cross-sections of Scofield. A detailed comparison between the experimental and theoretical E2 conversion coefficients revealed that (i) the theoretical values are over-estimations by a few percent and (ii) the deviation between theory and experiment seems to increase with proton number, neutron number and energy of the transition. (auth)

24904 VALIDITY OF DWBA METHOD IN (γ,α) REACTION. Majumder, A. R. (Decca Univ., Bangladesh); Chowdhury, M. S.; Sen Gupta, H. M.; Guichard, A. pp 57-59 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The DWBA method of extracting spectroscopic factors from (γ,α) reaction is beset with a number of difficulties and as such the reliability of the method as a spectroscopic tool is not without question. As an example we consider $^{51}V(\gamma,\alpha)$ reaction; the ΣC^2S value for l = 3, T < state is 12.2 and that from (d,t) reaction is 7.4 upto the same excitation energy of 3.2 MeV, the sum rule limit being 7.5. We have, therefore, studied the $^{51}V(\gamma,\alpha)$ reaction to make a detailed spectroscopic analysis, as well as to study the effects of different approximations in DWBA method. Using normalization constant N = 23, for T < states ΣC^2S were found to be 3.02, 0.40, 2.43 and 13.2 for l = 0, 1, 2 and 3 respectively and for T > states 0.30 and 1.71 for l = 0 and 3 respectively. The normalization N = 40 gives a good agreement with the shell model value. The discrepancy is otherwise due to the difficulty in deciding between l = 2 and l = 3 curves, finite admixture of l = 1 into l = 3 distributions; increasing r_0 from 1.20 fm to 1.24 fm yields ΣC^2S = 9.3 for l = 3, T < state. (auth)

24905 ANTICORRELATION IN LRA FISSION. Krishnarajulu, B.; Mehta, G. K. (Indian Inst. of Tech., Kanpur). pp 144-146 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The experimentally observed anticorrelation between the average total fragment kinetic energy (EF) and the α energy (E_α) could be of considerable importance in determining the correct set of initial values of, and correlations between, the initial parameters in trajectory calculations on LRA fission. It is observed that this anticorrelation can be reproduced by fixing the value of the initial interfragment distance, D. However, in doing so it is not possible to explain some asymptotic distributions, e.g. the angular distribution of the α particles; unless one assumes a correlation between D and the point of emission of the α particle, X_0. The exact nature of this correlation has not been determined as yet. We have also studied the anticorrelation as a function of the mass ratio, R. (auth)

24906 SIMPLE RELATIONS FOR THE EXCITATION ENERGIES E2 AND THE TRANSITION PROBABILITIES B(E2) OF NEIGHBORING DOUBLY EVEN NUCLIDES. Patnaik, R.; Patra, R.; Satpathy, L. (Berhampur Univ., Orissa, India). pp 150-153 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

For even-even nuclei, the excitation energy E2 and the reduced transition probability B(E2) between the ground-state and the first excited 2^+-state have been considered. On the basis of different models, we show that for a nucleus [N,Z], the relations E2 [N,Z] + E2 [N + 2, Z + 2] − E2 [N + 2, Z] − E2 [N, Z + 2] ≈ 0 and B(E2) [N,Z] + B (E2) [N + 2, Z + 2] − B (E2) [N + 2, Z] − B (E2) [N, Z + 2] ≈ 0 hold good except in certain specified regions. The goodness of the above difference equations is tested with the available experimental data. Previously, Ross and Bhaduri had proposed the following difference equation. If for an even-even nucleus [N,Z], the quantity $[E2B(E2)]^{-1}$ is denoted by F(N,Z) then F(N,Z) + F(N + 2, Z + 2) − F(N + 2, Z) − F(N, Z + 2) ≈ 0. This equation has been shown to follow from our considerations. On the basis of our equations some predictions of unmeasured E2 and B(E2) values are made to illustrate the possible use of the difference equations. (auth)

24907 EFFECTIVE INTERACTION IN p-SHELL NUCLEI AND THE REALISTIC INTERACTIONS. Upadhyaya, G. K. (Vikram Univ., Ujjain, India); Shriwastava, S. B.; Joshi, K. P. pp 154-156 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The effective interaction of Jain et al is analysed with relation to its spin-tensor structure. The interaction includes the effects of the prominant core-polarization diagrams to the Yale interaction. Comparison is made with the phenomenological interactions used successfully in the p-shell region. The general features of the effective interactions are discussed. (auth)

24908 OFF-SHELL CONTINUATION OF THE TWO-BODY T-MATRIX WHEN A BOUND STATE EXISTS. Lagu, A. V.; Maheshwari, C.; Mathur, V. S. (Banaras Hindu Univ., Varanasi, India). pp 162-164 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Following the procedure outlined by Haftel (1970) for the off-shell continuation of the two body t-matrix when a bound state exists, we have proposed a scheme for carrying such an analysis through numerically. In a model calculation we assume the "experimental" phase shifts, binding energy and the bound state to be those given by the Herzfeld potential. For this potential we also calculate the S-wave half shell functions which are to be taken as the exact ones. Then forgetting the potential itself and taking the corresponding S-wave phase shift, the bound state wave function and the bound state energy to be the known "experimental" quantities, we construct the S-wave half shell function using Haftel's procedure. Here we take the model potential to be the UPA to the Herzfeld potential (which can be known from the "experimental" bound state wave function and in turn reproduces the latter). A comparison is made between the "exact" half shell function and the half shell function obtained by the above scheme. (auth)

24909 GENERALIZED ROTATIONALLY INVARIANT CORE MODEL: A TWO MASS-POINT APPROACH. Prakash, V. R. (Indian Inst. of Tech., Kanpur). pp 176-178 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

A generalized RIC model for the rotational-vibrational spectra of deformed even-even nuclei of ellipsoidal shape in the rare-earth region has been proposed by incorporating many important features of various macroscopic models proposed earlier. The two mass-point model[1] and the governor model[2] moments of inertia are obtained on the basis of the proposed model with appropriate limiting values of the radius of the RIC. Also, the model moment of inertia goes to zero for spherical nuclei, thus giving no rotational spectra for such nuclei. A quantum mechanical treatment of the model on the basis of the two mass-point concept is expected to give results which are in better agreement with experiments. (auth)

24910 FADDEEV–YACUBOVSKY MODEL OF FOUR-NUCLEON SCATTERING PROBLEM WITH ACCOUNT OF SPIN AND ISOSPIN. Sharma, V. K. (D. S. Coll., Aligarh, India). pp 179-181 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The Faddeev-Yacubovsky model of four nucleons taking into account their spin and isospin with the two-channel resonating group approximation is considered. In this approximation, one employs a completely antisymmetric wave function which can be written as the clustering of d + d and n + He^3 (or p + ^3H) systems with antisymmetric spin-isospin states. The two-nucleon interactions used are of the separable Yamaguchi form in $^3S_1$ and ^3S states. The equations for the states with quantum numbers S = 0, 1, 2, T = 0 are obtained. It is shown that with subsequent separable representation of two-particle t-matrix reduces the equations to a set of one-dimensional coupled integral equations. (auth)

24911 PION CONDENSATION AND THE PRESENCE OF NUCLEON RESONANCES IN NUCLEAR MATTER. Panchapakesan, N. (Univ. of Delhi). pp 185-187 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The presence of mesons like pions inside the nucleus has been a matter for study for a long time. Recently it has been suggested that the pion could be in a resonant state with the nucleon and be present as a nucleon resonance Δ of mass 1236 Mev. The attractive interaction of the pion and nucleon in p-wave has also led to the suggestion that a condensate of coherent pions of same momenta may be formed in dense systems. We study the interaction of pions in nuclear matter with the static model. Following Bethe, we use the theory of refractive index and the requirement of unitarity. We conclude that the pions, if condensed, must be necessarily in a resonant state with the nucleon forming a Δ resonance. The critical density for appearance of the resonance is shown to be ~0.074 baryons F^{-3} much lower than the nuclear matter density of ~0.16 baryons F^{-3}. The presence of resonances in nuclei should, therefore, play a significant role in nuclear physics. (auth)

24912 ANALYSIS OF POLARIZATION OF MOTT SCATTERED ELECTRONS. Takwale, R. G. (Univ. of Poona); Teli, M. T. pp 196 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The method of elliptic relations between two degrees of scattered particles developed by Takwale and Teli is used here to analyse the polarization of electrons in Mott scattering by heavy nuclei by using Sherman's values of Mott functions for various velocities of incident electrons. It is found that for small values of scattering angle θ, electron velocity v and atomic number Z, the relation between the longitudinal (P) and perpendicular (P′) degrees of polarization is a circle while for large values of θ, v and Z, the relation represents an ellipse in which case the transverse degree of polarization P″ is related to P and P′ as P″ = a + bP + cP′. The parameters a, b and c depend on v and Z. The values of P″ calculated by this method for Z = 48 and 80 and v/c = 0.2, 0.6 and 0.9 agree to those given by Sherman for large θ. The variation of a, b, c and ellipse parameters such as centre (P_0,P'_0), angle of orientation of the axes γ_0 and lengths of semimajor-β and semiminor-α axes with v is also shown graphically. (auth)

24913 NUCLEAR STRUCTURE STUDIES THROUGH PROTON HOLE STATE FORMATION. Kaushal, R. S.; Monga, S. K. (Univ. of Delhi). pp 198-200 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

In order to understand the nuclear structure properties, we consider the formation of a real proton-hole state in nuclear matter by doorway mechanism and investigate the spreading widths of the hole states thus formed in relation to the particle-hole energy gap parameter (Δ) and the saturation nuclear density (k_F). Our calculations with rank two N-N separable potential of Mongan's type show that the $^1S_0$ free two-body force when inserted in the Bethe-Goldstone equation is strongly over repulsive in producing the widths of the expected magnitude. Our results, which are in agreement with others' investigations too, are further confirmed by detailed analysis using different values of the parameters Δ and k_F for the nuclear matter. (auth)

24914 SPECTRAL DISTRIBUTION APPROACH TO DEFORMATION ENERGY CURVES. Haq, R.; Parikh, J. C. (Physical Research Lab., Ahmedabad, India). pp 217 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The average deformation (quadrupole moment) of a nucleus as a function of the excitation energy is investigated within the SU(3) framework. An expression for the matrix elements of the quadrupole moment operator Q between states classified according to the SU(3) scheme has been given by Elliott. We use the form of the expression in the orbital angular momentum (L) projected scheme to evaluate the matrix elements of Q for a fixed projection M_L of L. The average quadrupole moment for a given representation ($\lambda\mu$) of SU(3) is then determined. The energy variation of Q_0 is obtained. These have been obtained by the application of the spectral distribution method to the group SU(3) by Parikh in the ds-shell. Results of the average deformation as a function of excitation energy for various nuclei in the ds-shell are different from the usual constrained Hartree-Fock results where one obtains the quadrupole moment of a specific type of state at a given energy. (auth)

24915 MESON THEORETIC RESTRICTIONS ON THE NUCLEON–NUCLEON T-MATRIX. Mukhopadhyay, S. K. (Tata Inst. of Fundamental Research, Bombay); Sauer, P. U. pp 224-225 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The nucleon–nucleon transition matrix T and not the potential V is close to experiment. A parametrization of T in momentum space, which avoids the cumbersome detour to a potential, but is consistent with our complete knowledge of the nuclear force, has, therefore, great practical and theoretical advantages. We consider here what makes the nucleon–nucleon T acceptable from the point of view of meson theory. We assume some analy-

ticity properties of the partial wave half-shell T in the complex (on shell) energy plane to put restrictions on its symmetric part in terms of the mesons and coupling constants of the virtual bosons exchanged. The full partial wave T is generated using the completeness and the orthogonality of the underlying scattering states and is unitary. Results regarding the $^1S_0$ partial wave will be discussed. (auth)

24916 PERTURBATIVE CALCULATION OF TWO-BODY T-MATRIX. Bhatia, R. P. (Panjab Univ., Chandigarh, India). pp 227 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

The on-shell two-body t-matrix is related directly to the scattering phase shift and the off-shell t-matrix can be given in terms of the on-shell t-matrix plus another term, the condition being that no bound state occurs in the related potential. The case when the potential has bound state is treated by breaking the potential into two parts such that neither contains a bound state. The t-matrix for the total potential is then calculated essentially in terms of the sum t_1 and t_2 of the two t-matrices. We simplify the total t-matrix by truncation. The approximation is best suited for high energies, but is also adequate for lower energies. Comparison is made between this approach and the t-matrix calculated by exact means, and gives satisfactory agreement. (auth)

24917 SQUARE WELL APPROXIMATION TO THE OPTICAL POTENTIAL. Jain, A. K.; Gupta, M. C.; Marwadi, P. R. (B.I.T.S., Pilani, India). pp 237-239 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

Approximations for obtaining T-matrix elements for a sum of several potentials in terms of T-matrices for individual potentials are studied. Based on model calculations for S-wave for a sum of two separable non-local potentials of Yukawa type form factors and a sum of two δ function type potentials, it is shown that the T-matrix for a sum of several potentials can be approximated satisfactorily over all the energy regions by the sum of T-matrices for individual potentials. Based on this, an approximate method for finding T-matrix for any local potential by approximating it by a sum of suitable number of square wells is presented. This provides an interesting way to calculate the T-matrix for any arbitrary potential in terms of Bessel functions to a good degree of accuracy. The method is applied to the Yukawa, exponential and the Saxon-Wood potentials and good agreement with exact results is found in all these cases. (auth)

24918 SEPARABLE NONLOCAL POTENTIAL FOR OPTICAL MODEL. Gupta, M. C.; Shastry, C. S. (B.I.T.S., Pilani, India). pp 240-242 of Proceedings of the Nuclear Physics and Solid State Physics Symposium. Vol. 17B. Bombay; Dept. of Atomic Energy (1974).

From proceedings of the nuclear physics and solid state physics; Bombay, India (27 Dec 1974). See CONF-741259-P17B.

In the neutron-nucleus optical model usually the complex local potential with Saxon-Wood radial form or Perey-Buck type nonlocal potentials are used for the neutron-nucleus potential. It is well known that the Schrodinger equation and the T-matrix for a separable finite rank potential for each partial wave can be solved exactly. However separable expansion for the Perey-Buck potential will be in fact an infinite series and difficult to obtain. Similarly the solution of the Schrodinger equation for the local optical potential with Saxon-Wood type radial form can be solved only numerically. In view of this we construct a single rank separable potential which will replace the local potential in optical model. We achieve this by approximating the local potential by a set of square well potentials and then constructing an equivalent one-term nonlocal separable potential for the latter for each partial wave for a given energy. The orbital angular momentum dependence of this potential comes from Bessel function of order $(l + \frac{1}{2})$. The usual parameters of the optical potential can be retained in this method to facilitate the least square calculation of the cross-section. Numerical calculations are carried out to illustrate this method. (auth)

24919 COMPARISON BETWEEN THE ADIABATIC TIME DEPENDENT HARTREE-FOCK AND THE GENERATOR COORDINATE METHODS FOR THE DESCRIPTION OF NUCLEAR COLLECTIVE MOTION. Villars, F. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). pp 3-17 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Attention is drawn to the essential equivalence of the two apparently quite distinct ways of describing nuclear collective dynamics, the adiabatic time-dependent Hartree-Fock method (ADTHF) and the Generator Coordinate (GC) method. An analysis of the simplest case, in which collective motion is described by a single collective parameter q(t) is presented. In the ATDHF approach, two self-consistency conditions are obtained; the resultant expressions for the collective potential and kinetic energies represent a special case of the more general results of Baranger and Veneroni. In the G.C. approach to the same system (with the same collective parameter q), the narrow overlap approximation must be made, as the counterpart of the adiabatic approximation in the TDHF method. In its conventional form, the G.C. method leads to a different expression for the collective kinetic energy. It is shown that a simple generalization of the G.C.-wave function leads to corrections determined by a variational principle. In leading order, the corrected expression for the collective kinetic energy is identical with the TDHF result. In both cases, the collective inertia is determined by a self-consistent cranking formula. (NL)

24920 ADIABATIC TIME-DEPENDENT HARTREE-FOCK THEORY OF NUCLEAR COLLECTIVE MOTION. Baranger, M. (Massachusetts Inst. of Tech., Cambridge (USA)). pp 19-22 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Four different ways of calculating the inertial function m(q) are compared, for a starting point consisting of a one-parameter family of time-even Slater determinants. (NL)

24921 WARD IDENTITY AND GVISR. Paar, V. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). pp 193-194 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The diagonalization results of the cluster-vibrational model (CVM) present a summation of all diagrams up to infinite order which in the intermediate states have the basic states included in the configuration space. However, it is often possible to find an easily manageable finite class of diagrams which dominate certain properties. This leads to a straightforward extraction of the basic physical properties from the CVM picture. The main qualitative pattern of such classes can then be expressed in terms of asymptotic Generalized Vibrational Intensity and Selection Rules (GVISR). The physical content of GVISR is discussed and the Ward identity is shown to be a physical basis. (NL)

24922 MANY BODY THEORY FOR FINITE NUCLEI (AND OTHER FERMI SYSTEMS). Kuemmel, H.; Luehrmann, K. H.; Zabolitzky, J. G. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). pp 195-216 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The principles of the exp(S)-form of many-body theory are outlined. The approximation method based on ordering according to the number of correlated nucleons is described and justified. Calculations including solutions of three-body Bethe-Faddeev equations with triple self consistency are reported and compared with experiments. The different definitions and interpretations of s.p. energies are critically discussed. (NL)

24923 NUCLEAR GROUND STATE PROPERTIES WITH THE SKYRME INTERACTION. Flocard, H. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). pp 219-254 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Some of the results concerning nuclear ground state properties obtained by Hartree-Fock calculations using the Skyrme's force are summarized. It is shown that a Skyrme Hartree-Fock method is able to reproduce the total binding energies of all nuclei of the chart table with a maximal discrepancy of 5 MeV. Charge radii and single particle spectra are also correctly calculated. The extrapolation of the calculations to exotic sodium isotopes and superheavy elements is presented and discussed. (NL)

24924 SELF-CONSISTENT CALCULATIONS OF GROUND STATE PROPERTIES FOR UNSTABLE NUCLEI. Beiner, M.;

Lombard, R. J. (Paris-11 Univ., 91-Orsay (France). Div. de Physique Theorique); Mas, D. (Orleans Univ., 45 (France). Lab. de Physique). pp 255-257 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

New results are obtained by applying a microscopic and self-consistent approach to the calculations of ground state properties of the very light nuclei, the Na-K- and Rb-isotopes as well as more than 300 spherical medium nuclei situated in the regions of the nuclear drip lines. (NL)

24925 SELF-CONSISTENT HYPERNUCLEI WITH THE SKYRME INTERACTION. Rayet, M. (Brussels Univ. (Belgium)). pp 258 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The good saturation properties of the Skyrme interaction have made it possible to obtain self-consistently reasonable estimates for the binding energy of the Λ hyperon inside various nuclei ranging from ^{16}O to ^{208}Pb. With a reliable self-consistent method for calculating hypernuclear binding it becomes possible to investigate also the characteristics of the Λ particle motion in particle excited states. The excitation spectra of the Λ particle in different hypernuclei are shown. (NL)

24926 GENERALIZED SKYRME INTERACTION WITH LOW INCOMPRESSIBILITY. Blaizot, J. P.; Grammaticos, B.; Liu, K. F. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Theorique). pp 259-260 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A generalized Skyrme interaction is presented which includes four body forces and a velocity dependence for the three and four body terms. The properties of nuclear matter can be well reproduced for various parameter sets. (NL)

24927 NEED TO MODIFY THE SKYRME INTERACTION SUGGESTED BY RPA CALCULATIONS. Blaizot, J.-P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Theorique). pp 261-262 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Since the particle-hole interaction can be considered as the derivative of the Hartree-Fock field with respect to the density matrix, one should expect that an effective interaction which leads to a good description of ground state properties could also give reliable results in the calculation of particle-hole excited states. In fact, due to the symmetries imposed in practice on the Hartree-Fock field, the adjustment of the parameters on ground state properties leaves arbitrary some components of the interaction. The Skyrme-force, for example, is fitted on ground states of even-even nuclei and therefore one adjusts only the part of the interaction which contributes to the S = 0 particle-hole channel. It is shown in particular that the S = 1 and T = 0 part needs to be modified. (NL)

24928 APPROXIMATION TO THE MOESSBAUER LINESHAPE INTEGRAL IN TERMS OF RATIONAL FUNCTIONS. Daniels, J. M. (Helsinki Univ. of Technology, Otaniemi (Finland)). Nucl. Instrum. Methods; 128: No. 3, 473-481(15 Oct 1975).

By replacing the exponential function e^{-xi} with a rational function R(xi) whose numerator and denominator are each of degree 2, the Moessbauer lineshape integral can be evaluated analytically, and the result expressed in terms of rational functions. Expressions are given for the lineshape integral, and its first and second derivatives with respect to the parameters which define the line. (NL)

24929 SHARED CHARACTER OF HOLE-STATE SINGLE-PARTICLE ENERGIES AND THE BINDING ENERGY OF NUCLEI. Harada, M. (Institute of Liberal Arts, Otaru University of Commerce, Otaru, Hokkaido, 047, Japan). pp 191-192 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The paper is concerned with the question of the validity of the relationship between the single-particle energy and the total binding energy of nuclei as given in a self-consistent microscopic theory such as the HF method or the Brueckner theory. The point of departure is the observation that the conventional single-particle potential takes no account of the obvious fact that the pair interaction energy is equally shared by two particles. A new single-particle potential definition is proposed and discussed. (NL)

24930 THERMAL PROPERTIES OF NUCLEI. Sauer, G.; Zint, P. G.; Mosel, U. (Giessen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). pp 397-398 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Experiments during the last few years have shown that deeply inelastic heavy ion collisions may deposit significant amounts of "heat" into nuclei. In order to predict the de-excitation of these nuclei it is necessary to know their thermal properties at high temperatures. Investigations of those properties have been undertaken starting from an effective nucleon-nucleon interaction while maintaining a single particle picture without any double counting of the interaction. For higher excitations also the influence of the excitation on the single particle spectrum and the single particle wave functions was to be taken into account. A suitable formalism for this purpose is given by the Hartree-Fock theory generalized for finite temperature. (NL)

24931 SYSTEMATICS OF GENERALIZED HARTREE-FOCK THEORY. Kelson, I. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). pp 405-423 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Multiparticle spaces are investigated, with special attention paid to deterministic measures, considerations of dimensionalities and statistical properties. The dependence of these functions on the energy of the state and on the characteristics of the Hamiltonian is analyzed. This provides a framework for generalizing the Hartree-Fock approximation, whose relevance to the study of the low lying spectra of physical systems is discussed. In particular, it is shown how approximate projection of angular momentum is effected. (NL)

24932 GREEN FUNCTION APPROACH TO PARTICLE-VIBRATION COUPLING. Baldo, M. (Catania Univ. (Italy). Istituto di Fisica Teorica). pp 425-426 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The problem of particle-vibration coupling is considered in the case of a particle coupled to a core, and the particle and phonon degrees of freedom are defined respectively by the single particle and density-density correlation functions. It is shown that it is possible to get an exact expansion of the single particle self-energy such that at any stage of the expansion the consistent equation of the phonon can be explicitly written. (NL)

24933 NOTE ON VARIATIONAL PROBLEMS WITH CONSTRAINED DEFORMATION. Fonte, G.; Schiffrer, G. (Catania Univ. (Italy). Istituto di Fisica Teorica). pp 427-428 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The authors suggest a redefinition of the deformation operator by taking a radial form factor, tending to zero rapidly enough as r → infinity, in such a way that a solution exists. A further requirement which should be satisfied is that the average value of the deformation operator defines a unique value of the collective coordinate, describing the shape of the nuclear surface. For numerical calculation one has to choose a model space and solve the equations by iteration. (NL)

24934 VARIATIONAL PROBLEMS WITH SMOOTH FUNCTIONALS. Fonte, G.; Schiffrer, G. (Catania Univ. (Italy). Istituto di Fisica Teorica). pp 429-430 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.), Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

It is well known that most linear operators representing physical observables in quantum mechanics are unbounded, so that their expectation values are not continuous functions in the Hilbert space of states H. This is a difficulty in the solution of variational problems; a method is proposed to overcome it by defining a new Hilbert space. (NL)

24935 BEST DENSITY CRITERION AND GEMINAL PRODUCT APPROXIMATION. Pacati, F. D.; Boffi, S. (Istituto Nazionale di Fisica Nucleare, Pavia (Italy)). pp 431-432 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

To study correlations the two-body density matrix D is needed. For this purpose a procedure is presented in which the starting point is the choice of a set of generating geminals, i.e., two-particle wave functions. For a particular choice of the generating set, the IPM can be reproduced. The method is applied to ^{4}He for different choices of the generating set of geminals and both the best-density criterion are used to fix the free parameters of the geminals. (NL)

24936 DEFORMED NUCLEAR DENSITY DISTRIBUTIONS DERIVED FROM AN ENERGY FUNCTIONAL. Stock, H.; Scheid, W. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 253: No. 1, 145-164(17 Nov 1975).

An energy functional is used to calculate non-spherical density distributions of protons and neutrons in a nucleus. Results are presented for the deformed region of $150 \leq A \leq 190$. (NL)

24937 CHARGE ASYMMETRY AND NEUTRON-NEUTRON SCATTERING. Wong, C. W.; Young, S. K.; Liu, K. F. (California Univ., Los Angeles (USA). Dept. of Physics). Nucl. Phys., A; 253: No. 1, 96-124(17 Nov 1975).

The uncertainty in the subtraction of electromagnetic effects from S-wave proton-proton scattering potentials is studied in two models using unitarily transformed potentials. Restrictions on these models caused by theoretical, off-shell and deuteron constraints are imposed. The probable uncertainty of physical interest is found to be small. It is typically only a few parts per thousand of the one-pion exchange potential. It has relatively little effect on Coulomb displacement energies. Phenomenological charge-symmetry-breaking potentials are constructed which both fit the experimental neutron-neutron (nn) scattering length (-16.4 fm), and give roughly the needed Coulomb displacement energies. These phenomenological potentials are found to contain a short-range repulsion and a strong long-range attraction for a neutron pair. The need for experimental information on the shape and state dependence of the nn force is emphasized. These can probably be obtained from precise nn scattering measurements. (NL)

24938 VALIDITY OF THE DENSITY MATRIX EXPANSION. Sprung, D. W. L.; Vallieres, M. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics); Campi, X. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire); Ko, C. M. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Phys., A; 253: No. 1, 1-19(17 Nov 1975).

The density matrix expansion of Negele and Vautherin is formulated in one dimension, and compared against an analytically soluble model. In three dimensions, numerical tests are carried out using both the Brink and Boeker force and the density-dependent force G-O. These range from perturbative to Hartree-Fock calculations. It is found that the DME method overbinds spherical nuclei by 1 MeV per particle compared to exact Hartree-Fock calculations. If the direct terms are calculated exactly and DME applied only to the exchange terms, the results are much better, with slight underbinding (about 200 keV per particle) occurring for most nuclei and the radii agree to within 1%. (NL)

24939 RECOIL TERM IN THE PARTICLE-ROTOR MODEL. Osnes, E.; Rekstad, J.; Gjoetterud, O. K. (Oslo Univ. (Norway)). Nucl. Phys., A; 253: No. 1, 45-54(17 Nov 1975).

The recoil term in the particle-rotor model is discussed in some detail. Expressions are given for the recoil term both in the absence and presence of pair correlations. It is concluded that the recoil term cannot be properly absorbed by other parts of the Hamiltonians and thus has to be explicitly evaluated. (NL)

24940 CONNECTION BETWEEN THE HYPERSPHERICAL HARMONIC AND GENERATOR COORDINATE METHODS FOR MONOPOLE VIBRATIONS. Navarro, J. (Paris-11 Univ., 91-Orsay (France). Div. de Physique Nucleaire). Phys. Lett., B; 59: No. 1, 13-14(13 Oct 1975).

It is shown that, when the generating functions are Slater determinants of harmonic oscillator wave functions, the generator coordinate method for monopole vibrations is identical to the first approximation of the hyperspherical harmonic method. (NL)

24941 NUCLEAR MATTER CALCULATIONS WITH MEAN SCALAR FIELDS. Pandharipande, V. R.; Smith, R. A. (Illinois Univ., Urbana (USA)). Phys. Lett., B; 59: No. 1, 15-18(13 Oct 1975).

The possibility is examined that nuclear-matter binding energy comes from the coupling of nucleons to a mean scalar field; vector fields are simulated by Yukawa potentials. It is found that the mean Schwinger σ field cannot explain the normal nuclear-matter saturation for any values of the coupling constants, while a simple scalar field with only quadratic terms is permitted. (NL)

24942 CONSTRAINED JASTROW CALCULATIONS. Owen, J. C.; Bishop, R. F.; Irvine, J. M. (Manchester Univ. (UK)). Phys. Lett., B; 59: No. 1, 1-3(13 Oct 1975).

An alternative to Pandharipande's lowest order constrained variational prescription for dense Fermi fluids is presented which is justified on both physical and strict variational grounds. Excellent results are obtained when applied to the "homework problem" of Bethe, in sharp contrast to those obtained from the Pandharipande prescription. (NL)

24943 LIMITS ON THE USE OF SKYRME FORCES. Sharp, R. W. Jr. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Phys. Lett., B; 59: No. 1, 4-8(13 Oct 1975).

Evidence is presented for interpreting Skyrme forces in terms of an expansion of the density matrix rather than as an expansion of the two body effective interaction. The domain of applicability of Skyrme forces is thereby demonstrated to be quite restricted. (NL)

24944 BRUECKNER-HARTREE-FOCK CALCULATIONS IN FINITE NUCLEI. Sauer, P. U. (Technische Univ. Hannover (F. R. Germany)). pp 89-112 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The Brueckner-Hartree-Fock theory of finite nuclei is reviewed. Numerical results for the ground-state properties of spherical nuclei are given. The results are compared with density-dependent Hartree-Fock calculations which employ effective forces derived in local-density approximation from nuclear matter. (NL)

24945 METHOD OF EVALUATION OF SINGLE CRYSTAL ^{57}Fe MOESSBAUER SPECTRA ($FeCl_2 \cdot 4H_2O$). Zimmermann, R. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany)). Nucl. Instrum. Methods; 128: No. 3, 537-543(15 Oct 1975).

A simple method for evaluating single crystal ^{57}Fe Moessbauer spectra with two quadrupolar lines is described. It is shown that the quadrupolar line intensities can be characterized by an intensity tensor. This tensor is proportional to the electric field gradient tensor (EFG) in the case of only one absorbing nucleus per unit cell. In case there are more the additivity of the intensity tensor leads to a macroscopic intensity tensor (analogous to the χ-tensor) from which it is easy to determine the manifold of local EFGs fitting the quadrupolar lines with the same efficiency. The actual local EFG can be found by additional investigation of a magnetic perturbed Moessbauer spectrum. The method is applied to $FeCl_2 \cdot 4H_2O$. (NL)

24946 SCATTERING LENGTH AND EFFECTIVE RANGE IN CLOSED FORM FOR THE COULOMB PLUS YAMAGUCHI POTENTIAL. Van Haeringen, H. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Nucl. Phys., A; 253: No. 2, 355-364(24 Nov 1975).

From the known expression for the off-shell T-matrix corresponding to the potential consisting of the sum of the Coulomb potential and the Yamaguchi potential, the physical scattering amplitude can be derived in a satisfactory way. Simple exact closed formulae are derived for the scattering length a_{cs} and the effective range r_{cs} from this amplitude. These are compared with approximate formulae derived by Harrington (1965). Also a few numerical calculations are reported and compared with results obtained by Harrington and by Ali et al. (1972). (NL)

24947 COUPLED CHANNEL T-OPERATOR EQUATIONS WITH CONNECTED KERNELS. II. N Coupled Two-Body Channels. Kouri, D. J. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)); Levin, F. S. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). Nucl. Phys., A; 253: No. 2, 395-428(24 Nov 1975).

A time-independent theory of rearrangement collisions involving transitions between two-body states is presented. It is assumed that the system of interest consists of particles that may be partitioned into two-body systems in N ways, including interchanges of particle labels without changing the kind of channel. An infinite family of sets of N coupled T-operator equations is derived by use of the channel coupling array, as in previous work on the three-body problem. Specialization to the channel-permuting arrays guaranteeing connected (N-1)th iterates of the kernel of the coupled equations is made in the N-channel case ($N > 3$) and the nature of the solutions to the coupled equations is discussed. Various approximation schemes to be used with

numerical calculations are suggested. Since the transition operators for all rearrangement channels are coupled together, no problems concerning non-orthogonality of the eigenstates of different Hamiltonians are encountered; also the presence of the outgoing wave boundary condition in all channels is made explicit. The close resemblance of the equations in matrix form to those of one-channel scattering is exploited by introducing Moeller wave operators and associated channel scattering states, an optical potential formalism that leads to rearrangement channel optical potential operators, and a variational formulation of the coupled equations using a Schwinge r-like variational principle. A brief comparison with other many-body formalisms is also given. (NL)

24948 NUCLEAR DENSITY DISTRIBUTION IN A ROTATING CYLINDRICAL POTENTIAL. Janecek, P. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., A; 253: No. 2, 448-460(24 Nov 1975).

A finite well potential of cylindrical shape is used to study the changes in the particle density distribution with rotation. Changes in the Coulomb energy and in the second moment $\langle r^2 \rangle$ are calculated for five nuclei with A between 40 and 220 and the deformation ratio 1 : 1 to 3 : 2. The critical angular momentum for particle emission is found to be M less than approximately A and the Coulomb energy to decrease by up to 3%. (NL)

24949 VALIDITY OF THE STRUTINSKY METHOD, STUDIED WITHIN THE HARTREE–FOCK FRAMEWORK. Brack, M.; Quentin, P. (Niels Bohr Institutet, Copenhagen (Denmark)). pp 353-394 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The foundation of the Strutinsky method within the Hartree-Fock (HF) framework is discussed. Both the basic energy theorem and the energy averaging method are investigated theoretically and numerically. The equivalence of the averaging method with semiclassical expansions is exhibited. Numerical tests of the basic assumptions of the shell-correction approach are presented, which make use of the results of constrained HF calculations for various nuclei and with different effective interactions. The HF energy is decomposed into a smooth part which is shown to be very close to a liquid drop model energy, a first order shell-correction defined in the usual way, and higher order corrections which usually are neglected in standard Strutinsky calculations. These higher order terms are shown not to contribute more than approximately 1-2 MeV to the total energy in medium and heavy nuclei. New results for the nucleus ^{40}Ca show that this is no longer the case for light nuclei. Alternative ways of defining the smooth part of the energy are also considered. It is particularly found that if the Strutinsky averaging is performed selfconsistently, the sum of the average energy plus the first order shell-correction extracted from the average potential reproduces perfectly well the exact HF energy. (NL)

24950 WHAT CAN WE STILL LEARN FROM MICROSCOPIC CALCULATIONS WITHOUT SELF-CONSISTENCY. Ko, C. M.; Pauli, H. C. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)); Brack, M.; Brown, G. E. (Niels Bohr Institutet, Copenhagen (Denmark)). pp 395-396 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

An investigation is made of how good the shell-model single-particle wave functions are in describing nuclear binding and deformation energies. (NL)

24951 HOW GOOD ARE HARTREE–FOCK CHARGE DENSITIES. Campi, X. (Paris-11 Univ., 91–Orsay (France). Div. de Physique Theorique). pp 271-294 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The principle characteristics of Hartree-Fock charge densities (mean square radius, surface thickness, quantum fluctuation) calculated using different effective interactions are discussed in terms of their nuclear matter properties (Fermi momentum, effective mass, incompressibility). A comparison with the experimental charge distributions is made. Differences between the charge densities of neighboring nuclei (isotope and isotone shifts) are also considered and the main factors governing these effects are discussed. (NL)

24952 QUANTITATIVE ANALYSIS OF MOESSBAUER BACKSCATTER SPECTRA FROM MULTILAYER FILMS. Bainbridge, J. (Central Electricity Research Labs., Leatherhead (UK)). Nucl. Instrum. Methods; 128: No. 3, 531-535(15 Oct 1975).

The quantitative interpretation of Moessbauer backscatter spectra with particular reference to internal conversion electrons has been treated assuming that electron attenuation in a surface film can be satisfactorily described by a simple exponential law. The theory of Krakowski and Miller has been extended to include multilayer samples, and a relation between the Moessbauer spectrum area and an individual layer thickness derived. As an example, numerical results are obtained for a duplex oxide film grown on pure iron. (NL)

24953 CANONICAL TRANSFORMATION METHOD WITH AUXILIARY COLLECTIVE VARIABLES AS A METHOD OF TREATING THE MUTUAL INTERWEAVING OF ELEMENTARY MODES OF EXCITATIONS IN NUCLEI. Kuriyama, A. (Kyushu Univ., Fukuoka (Japan). Dept. of Physics); Marumori, T.; Sakata, F. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study); Matsuyanagi, K.; Suzuki, T. (Kyoto Univ. (Japan). Dept. of Physics). pp 41-42 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The main purpose of the paper is to re-investigate usefulness of the canonical transformation method with auxiliary collective variables in treating the mutual interweaving of the elementary modes of excitations, in the light of the recent experimental and theoretical developments illuminating the structures of the elementary modes. Taking a general Hamiltonian, it is investigated to what extent the original many-fermion nuclear Hamiltonian may be effectively transformed into the "nuclear field Hamiltonian" described in terms of both (collective) boson and fermion degrees of freedom. Relation to the time dependent Hartree-Fock is also clarified. (NL)

24954 HYDRODYNAMICAL MODEL AND BEYOND. Sotona, M.; Zofka, J. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). pp 45-46 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A simple natural microscopic explanation of the 0^+ breathing of doubly magic nuclei is proposed. It is obtained by using the lowest order of the hyperspherical harmonics method. The A-body Schroedinger equation is reduced to a single equation in the hyperradius. As an example, this equation is solved with the two-body effective Gaussian interaction for doubly magic nuclei from ^{4}He to ^{208}Pb. (NL)

24955 SEMICLASSICAL DESCRIPTION OF A SYSTEM OF FERMIONS IN A ROTATING FIELD. Brack, M. (Niels Bohr Institutet, Copenhagen (Denmark)); Jennings, B. K. (McMaster Univ., Hamilton, Ontario (Canada)). pp 63-65 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A method for extracting the smoothly varying part of the energy of an independent particle system, using a semi-classical expansion of the partition function, has been proposed some years ago by Bhaduri and Ross (1971). It was recently applied to realistic finite depth potentials and the results were shown to be in good numerical agreement with other semi-classical methods. An application of this method to rotating nuclei is presented. (NL)

24956 INTERPRETATION OF MOESSBAUER SPECTRA OBTAINED WITH POLARIZED GAMMA-RAYS AND SINGLE CRYSTAL ABSORBERS. Daniels, J. M. (Helsinki Univ. of Technology, Otaniemi (Finland)). Nucl. Instrum. Methods; 128: No. 3, 483-493(15 Oct 1975).

The problem of calculating the intensities of the lines of Moessbauer spectra, using polarized γ-rays and polarized absorbers, is discussed with particular reference to ^{57}Fe. The subject is formulated so as to enable a set of measurements to be selected which will yield the maximum available information about the absorber, and the reduction of the measurements to more familiar terms (in some cases leading to a complete determination of the Hamiltonian of both the ground states and the excited state) is systematized. Examples are given. (NL)

24957 QUESTIONS ABOUT TWO CENTRE HF PROBLEMS. Dreizler, R. M.; Galbraith, H.; Lin, L. (Frankfurt Univ. (F.R. Germany). Inst. fuer Theoretische Physik). pp 30 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The model Hamiltonian is presented, discussing in what fashion the model represents a bound system, and whether it can reproduce the correct energy difference between the bound system and the (symmetrically) separated system. The discussion is based on the example ^{24}Mg reversibly yields 2 ^{12}C. The problems connected with a fissioning system such as ^{8}B reversibly yields 2 ^{4}He are also discussed. (NL)

24958 COUPLING BETWEEN ROTATIONS AND VIBRATIONS IN NUCLEI. Caldeira, M. H. (Coimbra Univ. (Portugal)). pp 31-32 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

As a contribution to the foundation of the theory of the collective quadrupole states of spherical nuclei, suitable theoretical techniques have been tested on the Moszkowsky model for values of the coupling constant appropriate to the transition region. The methods considered are the following 1) A boson expansion technique, including anharmonic terms, based on the generator coordinate method (G.C.M.) 2) The Peieris-Yoccoz method for rotations associated with the G.C.M. for vibrations of the intrinsic deformation. (NL)

24959 NEW VARIATIONAL PROCEDURE BASED ON THE DEFORMED-HARTREE-FOCK METHOD. Kumar, K. (Vanderbilt Univ., Nashville, Tenn. (USA). Dept. of Physics). pp 66-68 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A new variational procedure is discussed which allows one to compute the nuclear spectrum without having to project, that is having to integrate over different orientation angles. This method is capable of reproducing not only a rotational spectrum but also a vibrational one. Hence, it can be employed not only for well-deformed nuclei but also for soft or transitional nuclei. (NL)

24960 MICROSCOPIC APPROACH TO COUPLED MODES IN NUCLEI. Nadjakov, E. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). pp 69-70 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Ideas previously applied to nuclear rotation are extended to the coupling of low-lying collective modes in even-even nuclei. (NL)

24961 MICROSCOPIC THEORY OF ASYMMETRIC ROTOR. Sugawara-Tanabe, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study); Tanabe, K. (Saitama Univ., Urawa (Japan)). pp 71-72 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A determination is made of three subsidiary conditions, compatible with the commutation relation of angular momenta, which are needed in the microscopic theory of the asymmetric rotor. (NL)

24962 VALIDITY OF THE LOCAL DENSITY APPROXIMATION AND SIMPLE EFFECTIVE INTERACTIONS. Negele, J. W. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). pp 113-143 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A systematic approximation procedure in finite nuclei is presented which emphasizes the local behavior of the nuclear many-body wave function. An expansion of the density matrix about the center of mass of two interacting particles is utilized to understand the validity of the local density approximation and to derive a simple effective interaction embodying most of the physics of the realistic reaction matrix. The relation of this effective interaction to the Skyrme interaction and its theoretical limitations are discussed, and several extensions of the present theory are described. (NL)

24963 DYNAMIC INTERACTIONS FOR THE TWO-PARTICLE PROPAGATOR. Hahne, F.J.W.; Heiss, W. D.; Engelbrecht, C.A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). pp 144 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

In nuclear structure calculations the low-lying collective excitations of the core introduce dynamic effects in the residual interactions between particles. These effects can be taken into account by starting from the integral equation for the four-vertex function GAMMA. This equation can be transformed into a second order differential equation which is solved by making a series ansatz and determining the coefficients from recursion formulas. After inserting the correct boundary and matching conditions and transforming back to the energy-representation, the two-particle propagator K is calculated from the vertex GAMMA. The results are discussed. (NL)

24964 COMPARISON OF TWO VARIATIONAL CALCULATIONS IN THE BRUECKNER THEORY OF FINITE NUCLEI. Coon, S. A. (Arizona Univ., Tucson (USA)). pp 145-146 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Two calculations are compared, one of Brueckner-Hartree-Fock type and one of local density approximation type, which both include the particle-hole Pauli insertion. (NL)

24965 SATURATION DENSITY AND BINDING ENERGY OF NUCLEAR MATTER FROM A QUASI-PARTICLE APPROACH. Jeukenne, J. P.; Lejeune, A.; Mahaux, C. (Liege Univ. (Belgium)). pp 147-148 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The effect of the choice of U_o, an auxiliary single-particle potential energy, on the binding energy versus saturation density problem is discussed. (NL)

24966 EQUATION OF STATE AND THE MAGNETIC SUSCEPTIBILITY OF NEUTRON MATTER WITH REALISTIC N-N POTENTIALS. Haensel, P. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej); Meyer, J. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). pp 153 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

It is currently believed that pulsars are rapidly rotating neutron stars possessing very intense magnetic fields and hence the equation of state as well as the magnetic properties of the neutron star matter are of a considerable interest. These have been calculated for the Reid hard and soft core potentials. The rearrangement contributions, which are negligible at lowest density, being important at the highest densities considered, were calculated using the approximation of Brueckner and Gammel. In contrast to the case of liquid ^{3}He, where the lowest order Brueckner theory seems to be inadequate, this approximation when applied to neutron matter leads to the results, which are in agreement with the results obtained within the frame of the Landau theory of Fermi liquid. No sign of a tendency to a transition to ferromagnetic state was found. (NL)

24967 SPIN AND ISOSPIN DEPENDENCE OF THE NUCLEAR SINGLE-PARTICLE POTENTIAL. Dabrowski, J. (Warsaw Univ. (Poland)); Haensel, P. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). pp 154 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The spin and isospin dependence of the single-particle potential in nuclear matter is calculated within the frame of Brueckner theory. Numerical values of the spin and isospin dependent terms in the single-particle potential at the Fermi surface are calculated for the Brueckner-Gammel-Thaler, Hamada-Johnston and Reid soft-core potentials. The rearrangement effects are very important. The agreement of the calculated values with those resulting from the phenomenological estimates of the corresponding terms in the real part of the low energy nuclear optical model potential is satisfactory. The spin and isospin dependent terms in the optical model potential for medium and higher energies are calculated using the phase-shift approximation which includes some of the dispersive and exclusion principle effects of the nuclear medium. The results obtained for infinite nuclear matter are applied, using the local density approximation, to the calculation of the symmetry and spin-spin terms in the imaginary part of the nuclear optical model potential for finite nuclei. The volume integrals of the imaginary

spin-spin terms, for which up to now no phenomenological estimate was made, are an order of magnitude smaller than those corresponding to the symmetry term. (NL)

24968 SELF-CONSISTENT CALCULATION OF THE OPTICAL POTENTIAL, THE EFFECTIVE MASS AND THE BINDING ENERGY. Jeukenne, J. P.; Lejeune, A.; Mahaux, C. (Liege Univ. (Belgium)). pp 155-169 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The leading term of a low-density expansion for the complex optical model potential in nuclear matter is computed as a function of energy for various densities, from Reid's hard core nucleon-nucleon interaction. No free parameter is adjusted in the calculation. The non-locality and energy dependence of the real part are discussed. It is argued that the effective mass in nuclear matter shows a local enhancement at the Fermi surface, in keeping with empirical evidence. The complex optical-model potential in finite nuclei is constructed by a local density approximation: good agreement with phenomenological potentials is obtained. The binding energy and the Fermi momentum at saturation of nuclear matter are also computed and it is argued that it is sensible to identify the particle spectrum with the real part of the optical-model potential. The results are in much closer agreement with empirical values than in standard calculations where the potential energy is set to zero in intermediate states. (NL)

24969 INFORMATION ON NUCLEAR FIELDS DERIVED FROM EMPIRICAL DATA ON NUCLEAR EXCITATIONS. Hamamoto, I. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). pp 171-188 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The consistency of the strength of the particle-vibration coupling is discussed. By using the particle-vibration coupling model, the shifts of the single-particle energies due to the core-polarization are estimated in the ^{208}Pb region. Then, the interpretation of the observed "single-particle spectra" is discussed. (NL)

24970 BRUECKNER-HARTREE-FOCK APPROACH TO THE OPTICAL-MODEL POTENTIAL. Jeukenne, J. P.; Lejeune, A.; Mahaux, C. (Liege Univ. (Belgium)). pp 189-190 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

Equations are presented for the calculation of the optical model potential as a function of E and of the distance from the nuclear center by using a local density approximation and an empirical density distribution. Theoretical results are presented for a nucleus, A = 170 at E_{cm} = 10 MeV and a nucleus A = 56 at E_{cm} = 230 MeV. (NL)

24971 CONSTRUCTION OF TRANSLATIONALLY INVARIANT DEFORMED WAVE FUNCTIONS. Guardiola, R. (Universidad Autonoma de Barcelona (Spain)). Nucl. Phys., A; 253: No. 2, 289-300(24 Nov 1975).

Translationally invariant nuclear wave functions are constructed from deformed harmonic oscillator shell-model wave functions, with an exact projection of angular momentum quantum numbers. It is shown that the computation of matrix elements with the translationally invariant wave functions is as simple as the standard calculation, and formulae are obtained for (i) the potential energy, (ii) the kinetic energy and rms radius, and (iii) the charge form factor. (NL)

24972 COMPENSATION OF THE PARAMAGNETIC EFFECT OF H_{c_2} BY MAGNETIC MOMENTS: 700 kg SUPERCONDUCTORS. Fischer, O. (Geneva Univ.); Decroux, M.; Chevrel, R.; Sergent, M. J. Phys., C (London); 8: No. 21, L474-L477(7 Nov 1975).

An increase of about 50 to 100 kG of the upper critical field is observed in $Sn_{1.2(1-x)}Eu_xMo_{6.35}S_8$ and $Pb_{1-x}Eu_xMo_{6.35}S_8$ with respect to the compounds without Eu. This increase, due to the Jaccarino-Peter compensation effect, pushes H_{c_2} up into the vicinity of 700 kG. (auth)

24973 INVESTIGATION CONCERNING THE DYNAMICS OF NUCLEAR FISSION. Lichtner, P. Mainz; Mainz Univ. (1974). 136p. (In German). INIS.

Thesis.

The work deals with the nuclear fission theory with particular regard to the dynamics of the fission process. The various models for calculating the classical Hamilton function of collective motion — Strutinsky method, Hartree-Fock method with secondary conditions (CHF), cranking model, were discussed in detail. The general problem of quantization in the curved space was considered together with the general methods for simplifying the Schroedinger equation with variable mass. (DE)

24974 NOTE ON THE FOUNDATION OF THE α-DECAY WIDTH. Dumitrescu, O. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys.; 20: No. 6, 641-644(1975).

The new definition given by Kadmensky et al of the resonance level width occurring in compound reactions, scattering or decay processes is modified. The correction is made within the α-decay theory without loss of generality of the basic expression. (SDF)

24975 CORRELATED MODEL OF THE NUCLEAR PHOTOEFFECT. Ristig, M. L.; Clark, J. W. (Washington Univ., St. Louis). Nuovo Cim., 30A: No. 4, 609-631(21 Dec 1975).

A model is constructed for direct photonuclear reactions at intermediate energies, which incorporates the effects of short-range correlations in the initial and final nuclear states. The model is the first consistent one of this type in that spurious contributions to the transition amplitude due to nonorthogonality of approximate correlated initial and final nuclear states are eliminated and the model transition amplitude is developed in a well behaved cluster expansion, with terms arranged in increasing order in a smallness parameter characterizing the correlations. The zeroth-order term gives the conventional shell model description. Explicit expressions for the transition amplitude valid to first order in the effects of the correlations are derived for use in analyses of the (γ,N) and $(\gamma,2N)$ data, under the special assumption that the correlations in initial and final states are of the same Jastrow form. (auth)

24976 THEORY OF ENERGY DISSIPATION IN HEAVY-ION REACTIONS. Mshelia, E. D.; Scheid, W.; Greiner, W. (Inst. for Theoretical Physics, Frankfurt am Main). Nuovo Cim., 30A: No. 4, 589-608(21 Dec 1975).

A formalism for the description of energy dissipation in heavy-ion reactions within the two-center shell model is proposed. Dissipation is considered as due to the coupling of relative motion to mtrinsic degrees of freedom. First, the formulation is carried out quantum mechanically. The problem reduces to the solution of coupled integro-differential equations for energy distribution functions $f_n(\beta)$ and $\overline{f}_\epsilon(\beta)$, where $|\overline{f}_\epsilon(\beta)|^2 d\epsilon$ is the probability of finding the intrinsic energy within the interval ϵ and $\epsilon + d\epsilon$. By introducing suitable boundary conditions with incoming and outgoing waves the equations can be solved by iterative methods. The second method is based on the semi-classical approximation and is formulated in the time-dependent picture. Finally, a relation between the friction coefficient and the distribution functions is given. (auth)

24977 FINAL-STATE INTERACTIONS IN PION PHOTOPRODUCTION FROM NUCLEI. Haendel, R.; Weise, W. (Univ., Erlangen, Ger.). Lett. Nuovo Cim.; 14: No. 16, 592-596(20 Dec 1975).

The strong influence of pion–nucleus final-state scattering corrections on the cross sections for pion photoproduction from nuclei, and consequently, the extreme difficulty of extracting nuclear-structure information from photoproduction experiments, unless the mechanism of the pion–nucleus interaction is fully understood. A comparison between calculations with and without pion–nucleus final-state interactions is carried out to illustrate their influence. (JFP)

24978 TENSOR POTENTIAL, NEUTRON–PROTON PAIRING AND NUCLEAR DEFORMATION. Palumbo, F. (Univ., Rome). Lett. Nuovo Cim.; 14: No. 16, 572-576(20 Dec 1975).

The previous energy gap estimation for infinite nuclear matter for different nucleon–nucleon pair states is considered unsatisfactory. The present analysis leads one to consider a neutron–proton pairing which should be a characteristic feature of deformed nuclei. (JFP)

24979 POSSIBLE MAGICITY OF SUPERHEAVY NUCLEI. Rahman, M. (Univ. of Rajshali, Bangladesh); Salimullah, M.; Sen Gupta, H. M. Lett. Nuovo Cim.; 15: No. 1, 27-31(3 Jan 1976).

It is found that there is a possibility of neutron magic number at 184 only, but the gaps at N = 164 and 228 and at Z = 114 are not sufficient for stability, while the level at Z = 126 is unbound. In the present calculation the neutron and proton potential anomaly was removed through the incorporation of the isospin potential. (JFP)

24980 NEUTRON MAGNETIC FORM FACTORS OF URANIUM IONS. Freeman, A.J. (Northwestern University, Evanston,

Illinois 60201); Desclaux, J.P.; Lander, G.H.; Faber, J. Jr. Phys. Rev. B 13: No. 3, 1168-1176 (1 Feb 1976).

The radial $\langle j_l \rangle$ integrals, which contribute to the neutron magnetic form factors, of several uranium ions (U^{3+}, U^{4+}, U^{5+}) are determined from fully relativistic Dirac-Fock wave functions. The expectation values of the r^n operators, $\langle r^n \rangle$, with $n = -3$, 2, 4, and 6 are given for the uranium ions. The possibility of determining the ionization state by magnetic scattering experiments is discussed. The radial $\langle j_l \rangle$ integrals are used to analyze the experimental form factor of US determined by Wedgwood. Satisfactory agreement is found by choosing a $5f^2$ Γ_1 crystal-field ground state with a large internal exchange field inducing ferromagnetism. Contributions to the magnetic scattering from $6d$ electrons are found to be negligible for values of $\sin\theta/\lambda > 0.2$ Å^{-1}. (auth)

24981 SEARCH FOR STABLE, ABNORMAL (COLLAPSED) NUCLEI IN NATURE. Holt, R.J.; Schiffer, J.P.; Specht, J.; Bollinger, L.M.; Thomas, G.E. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439); Fried, S.M.; Hines, J.J.; Friedman, A.M. Phys. Rev. Lett. 36: No. 4, 183-186 (26 Jan 1976).

Very tightly bound, abnormally-high-density states of nuclei, suggested as a possibility by Bodmer and by Lee and Wick, have been searched for as an anomalous isotope of radon. This was done by looking for high-energy γ rays following thermal-neutron capture. The limit that may be set for the atomic concentration of such nuclides on Earth is $\sim 10^{-29}$ atom of Si. (auth)

24982 UNITARITY RELATION FOR THE OPTICAL POTENTIAL. Ernst, D.J. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106); Thaler, R.M. Phys. Rev. Lett. 36: No. 4, 222-224 (26 Jan 1976).

It is shown that the impulse approximation of Watson satisfies many-body unitarity to within terms which represent scattering from two different target particles. A systematic development further defines the nth-order optical potential such that unitarity is satisfied to within scattering from $n+1$ different target nucleons. (auth)

24983 EXCHANGE EFFECTS IN THE THEORY OF RADIOACTIVE DECAY. Tobocman, W. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 13: No. 2, 790-798 (Feb 1976).

A nuclear reaction theory derivation of the decay width for radioactive decay by particle emission is given. Particular attention is devoted to exchange symmetry. The result is similar in form to that derived by Fliessbach using time dependent perturbation theory except that in our expression the wave function for the emitted particle is the solution of a Schrödinger equation, whereas Fliessbach finds that this function must be calculated from a Hill-Wheeler equation. (auth)

24984 HEAVY-ION DISTORTED-WAVE BORN-APPROXIMATION RECOIL TO SECOND ORDER IN A TAYLOR SERIES. Baltz, A.J. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 13: No. 2, 668-673 (Feb 1976).

The perturbative approach for rapid calculation of recoil corrections to the heavy-ion distorted-wave Born approximation has been extended to second order without further approximation. The resulting calculational scheme turns out to be so well converged as to be essentially exact finite range for single nucleon transfer at energies not too far above the Coulomb barrier. (auth)

24985 OFF-ENERGY-SHELL CONTINUATION OF THE NUCLEON-NUCLEON AND MESON-NUCLEON TRANSITION MATRICES IN THE PRESENCE OF INELASTICITIES. Sauer, P.U.; Sevgen, A. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. C 13: No. 2, 720-729 (Feb 1976).

A technique for constructing the nucleon-nucleon transition matrices T in the presence of inelastic channels is given. The present technique avoids the usual potential fit and continues T off the energy shell directly consistent with the two-body scattering data and consistent with the properties of possible two-body bound states. The respective T matrices are determined by a real symmetric matrix function $\langle E_1\alpha_1|\sigma|E_2\ \alpha_2\rangle$ of the continuous energy variable E and the discrete eigenchannel label α. The on-shell part of σ is given by the eigenphases; the arbitrariness of T is the off-shell continuation of the phase-shift matrix $\langle E\alpha_1|\sigma|E\alpha_2\rangle$ into two dimensions. The present technique of constructing T makes the experimental nucleon-nucleon and meson-nucleon scattering data readily available as input for nuclear theory extended to include baryon resonances. (auth)

24986 OFF-ENERGY-SHELL VARIATIONS OF TWO-NUCLEON TRANSITION MATRIX AND THREE-NUCLEON PROBLEM. Stingl, M; Sauer, P.U. (University of Freiburg, Freiburg i. Br., West Germany). Ann. Phys. (N.Y.) 94: No. 2, 258-306 (Oct 1975).

For a schematic three-nucleon problem, we derive approximate analytic expressions for the functional derivatives of measurable three-particle quantities with respect to off-shell variations of the triplet-s, two-nucleon transition matrix. Those quantities include neutron-deuteron scattering lengths, trinucleon binding energies, and the ^{3}He charge form-factor minimum; correlations between off-shell changes in the latter two are discussed. We indicate how results of this kind may be used to decide whether or not a given set of discrepancies between calculated and experimental three-nucleon observables can be reconciled in terms of off-shell variations of a nonretarded hermitian two-nucleon interaction. The treatment is not restricted to special classes of phase-shift equivalent potentials or phase-shift preserving transformations but instead makes use of a systematic parameterization of off-shell variations in terms of symmetric rational approximants of increasing order. (auth)

24987 ANOMALOUS THRESHOLDS IN AN N/D APPROACH TO NUCLEAR REACTIONS. Greben, J.M. (Nuclear Physics Accelerator Institute, Groningen, The Netherlands); Kok, L.P. Phys. Rev. C 13: No. 2, 489-509 (Feb 1976).

The applicability of a recently developed coupled channel N/D approach to nuclear reactions is extended to those cases where one of the channels contains a loosely bound particle giving rise to an anomalous threshold. The N/D equations for the anomalous case are obtained by continuing the amplitudes in some external variable. We show that it is necessary to include part of the second order Born term in order to avoid certain singularities of the amplitudes in this external variable. The N/D equations which are derived for the anomalous case are very similar to those in the normal case and quite amenable to numerical calculations. We also analyze the singularity structure of the second order Born terms in the energy plane. The occurrence of other types of singularities of the amplitudes in the external variable is investigated and their physical relevance is discussed. (auth)

24988 POSSIBILITY OF DETECTING DENSITY ISOMERS IN HIGH-DENSITY NUCLEAR MACH SHOCK WAVES. Hofmann, J.; Stöcker, H.; Heinz, U.; Scheid, W.; Greiner, W. (Institut für Theoretische Physik der Universität Frankfurt am Main, Frankfurt am Main, Germany). Phys. Rev. Lett. 36: No. 2, 88-91 (12 Jan 1976).

Up to now no experimentally feasible method for detecting abnormal nuclear states has been known. We propose to observe them in high-energy heavy-ion collisions through the disappearance of, or irregularities in, high-density nuclear Mach shock phenomena. (auth)

24989 CHARACTER OF THE PHASE TRANSITION IN π CONDENSATION. Dyugaev, A.M. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). JETP Lett. 22: No. 3, 83-85 (5 Aug 1975).

Correlation effects accompanying the formation of pion condensate are considered. An attracting long-range $\pi\pi$ interaction exists near the transition point. The condensate is the result of a first-order transition with a small jump of the meson field. (auth)

PHYSICS (RADIATION AND SHIELDING)

24990 (UCRL-5007-75-1) HAZARDS CONTROL PROGRESS REPORT NO. 50, JANUARY–JUNE 1975. Mendenhall, V. R. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1975. Contract W-7405-Eng-48. 49p. Dep. NTIS $5.00.

Progress report for January through June 1975. Of the five progress reports and four technical notes, abstracts of nine items appear separately in ERA, and six appear in NSA. (GHT)

For abstracts of individual papers see: 23069, 23381, 23382, 23881, 24998, and 24999.

Radiation Physics

Refer also to abstracts 22928, 23399, and 25007.

24991 (CONF-741040–P2, pp 102-113) MEASUREMENTS OF ABSORBED ENERGY DISTRIBUTIONS IN WATER FROM PULSED ELECTRON BEAMS. Devanney, J. A. (Bureau of Radiological Health, Rockville, MD). 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

An evaluation of the use of a holographic interferometer to measure the energy deposition as a function of depth in water from pulsed electron beams, together with a brief description of the interferometer and the technique of generating a hologram are presented. The holographic interferometer is used to measure the energy deposition as a function of depth in water from various pulsed beams of monoenergetic electrons in the energy range from 1.0 to 2.5 MeV. These results are compared to those computed by using a Monte Carlo radiation transport code, ETRAN-15, for the same electron energies. After the discrepancies between the measured and computed results are evaluated, reasonable agreement is found between the measured and computed absorbed energy distributions as a function of depth in water. An evaluation of the response of the interferometer as a function of electron intensities is performed. A comparison among four energy deposition curves that result from the irradiation of water with pulsed electron beams from a Febetron accelerator, model 705, is presented. These pulsed beams were produced by the same vacuum diode with the same charging voltage. The results indicate that the energy distribution of the electrons in the pulsed beam is not always constant. A comparison of the energy deposition curves that result from the irradiation of water with electron pulses from different vacuum diodes but the same charging voltage is presented. These results indicate again that the energy distribution of the electrons in the pulsed beam may vary between vacuum diodes. These differences would not be realized by using a totally absorbing metal calorimeter and Faraday Cup.

24992 (CONF-751101-53) PEDIATRIC PHANTOMS FOR USE IN DOSIMETRIC CALCULATIONS. Shoup, R. L.; Hwang, J. L.; Poston, J. W.; Warner, G. G. (Oak Ridge National Lab., Tenn. (USA)). 1976. 14p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Estimating absorbed doses to children from external and internal radiation sources has become important to the nuclear industry and pediatric nuclear medicine. The Medical Physics and Internal Dosimetry Section at ORNL has recently completed the design of mathematical representations of children of ages newborn, 1-year, and 5-years old. These mathematical representations will be referred to as pediatric phantoms. Using these phantoms, relevant energy deposition data have been developed which establish a meaningful model for use in estimating radiation dose to children. (auth)

24993 (CONF-751101-56) PRELIMINARY CROSS-SECTION SENSITIVITY ANALYSIS FOR AN AIR-OVER-GROUND ENVIRONMENT. Pace, J. V. III; Bartine, D. E. (Oak Ridge National Lab., Lab., Tenn. (USA)). 1976. 4p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Two-dimensional sensitivity calculations were made for an air-over-ground geometry to determine the effect of air and ground cross-section perturbations on the total neutron and gamma ray dose near the air/ground interface and 415 meters above the ground. ENDF/B 22 neutron and 18 gamma group Version IV cross-sections were used in all computations. (auth)

24994 (HEDL-SA-734) IMPROVED MULTIGROUP REPRESENTATION OF DIFFERENTIAL COMPTON SCATTERING CROSS SECTIONS. Ward, J. T. Jr. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 19p. (CONF-750607-46). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A modification of the multigroup transport calculations that employ expansions in terms of Legendre polynomials to represent anisotropic scattering phenomena is presented. The modification virtually eliminates the oscillatory behavior of group-to-group differential scattering cross sections generated without it. (GHT)

24995 (NIRS-14, pp 1-12) PHYSICAL SCIENCES. Sep 1975.

In annual report, 1974.

Brief summaries are given of work in the following areas: correction functions for optimization of reconstructed images, a multicrystal section imaging device, dose conversion factors, estimation of population doses, x-ray dosimetry, scattering of high-energy x rays, neutrons from the Li(d,n) reaction, calculation of absorbed doses near interface from $^{10}B(n,\alpha)$ reaction, selective adsorption of ^{137}Cs in concentrated solution containing ^{59}Fe, ^{60}Co, ^{65}Zn, ^{95}Zr, ^{144}Ce, and ^{85}Sr by nickel hexacyanoferrate (II), synthesis of 2-thio-6-norbornyl derivatives, and an ESR study of transient intermediate in the copper-catalyzed oxidation of cysteine. Complete papers on these topics appear in various journals. (RWR)

24996 (UCID-17005) USE OF IMPLICIT MONTE CARLO RADIATION TRANSPORT WITH HYDRODYNAMICS AND COMPTON SCATTERING. Fleck, J. A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1971. Contract W-7405-Eng-48. 12p. Dep. NTIS $3.50.

It is shown that the combination of implicit radiation transport and hydrodynamics, Compton scattering, and any other energy transport can be simply carried out by a "splitting" procedure. Contributions to material energy exchange can be reckoned separately for hydrodynamics, radiation transport without scattering, Compton scattering, plus any other possible energy exchange mechanism. The radiation transport phase of the calculation would be implicit, but the hydrodynamics and Compton portions would not, leading to possible time step controls. The time step restrictions which occur on radiation transfer due to large Planck mean absorption cross-sections would not occur. (GHT)

24997 (UCID-17012) EQUATIONS FOR A TWO-DIMENSIONAL DIFFUSION ROUTINE. Sutcliffe, W. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1974. Contract W-7405-Eng-48. 23p. Dep. NTIS $3.50.

The equations for a two dimensional diffusion routine including boundary conditions and flux limiting are presented. The method of solution is simply a reduction to one dimension by ADI or splitting and application of the usual back substitution method. (auth)

24998 (UCRL-5007-75-1, pp 1-8) RADIATION PROTECTION: THEORETICAL STUDIES OF X-RAY ATTENUATION IN A SIMULATED CHEST WALL. 15 Aug 1975.

In hazards control progress report No. 50, January–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Topics covered include: theoretical studies of x-ray attenuation in a simulated chest wall; response of the LLL personnel TLD badge to penetrating and nonpenetrating radiation; and fabrication of a realistic torso phantom for calibration of heavy-element lung counters. (GHT)

24999 (UCRL-5007-75-1, pp 28-34) RADIATION PROTECTION: AN UNUSUAL PROBLEM IN TRITIUM DOSIMETRY: TRITIUM IN GLASS. 15 Aug 1975.

In hazards control progress report No. 50, January–June 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Topics presented are: an unusual problem in dosimetry; tritium in glass; fission-neutron-scattered dose contributions in the low-scatter facility; air-scattered fast-neutron dose rate; and neutron spectrum at the Livermore pool-type reactor. 4 figures, 6 tables. (GHT)

25000 MEASUREMENTS OF RANGE AND RANGE STRAGGLING OF LOW ENERGY PIONS AND MUONS. Lagerlund, T. D.; Blecher, M.; Gotow, K.; Jenkins, D.; Lam, W. C. (Virginia Poly-

technic Inst. and State Univ., Blacksburg (USA)). Nucl. Instrum. Methods; 128: No. 3, 525-529(15 Oct 1975).

Using a stack of multiwire proportional chambers with interspersed absorbers, the authors have measured the range distributions of low energy pions and muons, and have obtained the mean range and range straggling (deviation about the mean) and compared them with the calculations of Janni. The percent differences between the actual incident energies and those calculated from the mean range were 2.37% for 39.3 MeV μ^+, 1.13% for 37.6 MeV π^+, 0.608% for 33.0 MeV π^+, 0.303% for 33.0 MeV π^-, and 0.854% for 37.6 MeV π^-. These differences are less than the expected errors in the range calculations. The ratios of the observed to the predicted range straggling for the corresponding particles and energies were 1.0, 1.2, 1.4, 1.4, and 1.2 (accurate to about ±10%.) (NL)

25001 POST-DAVYDOV SOLUTION WITH THIRD ORDER ACCURACY FOR THE ELECTRON DISTRIBUTION FUNCTION IN WEAKLY IONIZED GASES. Cavalleri, G.; Bonalumi, R. (Centro Informazioni Studi Esperienze, Milan (Italy)). pp 4 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

An explicit solution for the electron distribution function $f(\nu,\mu)$ in a weakly ionized gas in steady-state and uniform conditions and for dominant elastic collisions, is given to within $0(\epsilon^4) = 0(m^2\ M^2)$ where m and M are the masses of the electron and of the molecule respectively. In particular the isotropic component $f_0(\nu)$ is given with improved accuracy with respect to the Davydov solution. Also the collision source $\chi(\nu,\mu)$ is obtained as a function of $f_0(\nu)$. (NL)

25002 ORDERS OF APPROXIMATION IN TRANSPORT THEORY FOR ELECTRONS OR HOLES IN A SCATTERING MEDIUM. Cavalleri, G.; Gatti, E. (Centro Informazioni Studi Esperienze, Milan (Italy)); Gonzalez-Gascon, F. (Milan Univ. (Italy)). pp 3 of Phenomena in Ionized Gases. Vol. I. Hoelscher, J. G. A.; Schram, D. C. (Eds.). Amsterdam; North Holland Publishing Company (1975).

From 12th international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

In the framework of the path integral method, a transport quantity for free electrons (or holes) either in gases or in semiconductors in the presence of a static and uniform electrical field E, can be expressed as a sum of terms, each containing as a factor a properly indexed function $v_{(j)(s)} = V_{(j)(s)(eE/m)}$ which can be reduced to a rapidly convergent series of integrals over the thermal electron speed v. In a wide variety of cases, the integrals can be solved by series expansion, and $V_{(j)(s)}$ turns out to be given by a rapidly converging series of $(W^2/\langle v^2\rangle) \ll 1$, where W is the drift velocity. This ratio for elastic collisions can reach an asymptotic value (for high E fields) of the order $\epsilon^2 = m/M$ where m and M are the masses of the electron and of a scattering center respectively. (NL)

25003 CONVERSION EFFICIENCY OF LEAD FOR 30 TO 200 MeV PHOTONS. Darriulat, P.; Gygi, E.; Holder, M.; McDonald, K. T.; Pugh, H. G.; Schneider, F.; Tittel, K. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 129: No. 1, 105-107(1 Nov 1975).

The conversion efficiency of lead has been measured as a function of thickness for 44 MeV, 94 MeV and 177 MeV photons, and as a function of energy between 29 MeV and 177 MeV for thickness of one and two radiation lengths. Some additional information on multiplicity of secondary tracks and on their angular distribution was obtained using a small streamer chamber. The results obtained confirm the shower calculations of Messel and Crawford. (NL)

25004 ENERGY LOSS AND ENERGY LOSS STRAGGLING OF N, Ne, AND Ar IONS IN THIN TARGETS. Efken, B.; Hahn, D.; Hilscher, D.; Wuestefeld, G. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Kern- und Strahlenphysik). Nucl. Instrum. Methods; 129: No. 1, 219-225(1 Nov 1975).

The energy loss and energy loss straggling of N, Ne, and Ar ions have been measured in He, N_2, SF_6, and Ar windowless gas targets and in carbon foils at energies of 5-15 MeV. The experimental results of the energy loss straggling are approximately a factor of 1.5 and 2.0 larger than the straggling calculated from the collision straggling for Ne and Ar ions, respectively. Charge exchange straggling has to be taken into account in order to explain the experimental findings. The measured energy loss agrees very well with the Bethe formula if the measured averaged squared charge state in gaseous targets is being used. Deviations to the tables of Northcliffe are of the order of 10-30%. (NL)

25005 TRANSFORMATION OF IONIZATION MEASUREMENTS TO THE ABSORBED DOSE IN THE DOSIMETRY OF HIGH-ENERGY BEAMS OF RADIATION. Rytina, K. Cesk. Radiol.; 28: No. 1, 61-68(1974). (In Czech)

The energy spectrum measurement of primary and secondary electrons during their passage through the irradiated medium as well as the measurement of the primary electron energy and the secondary electron energy ratio, carried out by Harder, permits determination of the mean energy of electrons in the irradiated medium. It is then possible to determine this energy (up to 40 MeV), the corresponding conversion factor K^c, and its dependence on depth. Considerations concerned with the spectral composition of primary beams of Bremsstrahlung and of secondary electrons led to the determination of the medium energy of secondary electrons in relation to the maximum energy in the spectrum of the primary beam or to the energy of accelerated electrons in the accelerator. With the thus determined energy the conversion factor for the Bremsstrahlung K^x is determined. The dependence of the corresponding conversion factors for the electron beam on the depth in water for the given initial electron energy and the influence of this correction on the curve of depth-doses are interpreted with several graphs. (auth)

Radiation Protection Standards

Refer also to abstracts 23487 and 24990.

25006 (CONF-741040-P2, pp 298-309) PROTON RADIOGRAPHY FOR MEDICAL APPLICATION. Moffett, D. R. (Argonne National Lab., IL). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

A proton beam attenuates very rapidly at the end of its range. This property makes such a beam a very sensitive probe of small density variations in human tissue. A team from the Zero Gradient Synchrotron at the Argonne National Laboratory and from the University of Chicago Medical School is working on the development of proton radiography as a practical diagnostic tool. This work includes development of a suitable electronic beam detector and a suitable accelerator.

25007 (CONF-741040-P2, pp 324-333) USE OF CYCLOTRONS IN CANCER THERAPY. Smathers, J. B. (Texas A and M Univ., College Station); Otte, V. A.; Almond, P. R.; Smith, A. R.; Hussey, D. H. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Vol. II. (North Texas State Univ., Denton (USA)).

Patient neutron therapy is presently in progress at several institutions using cyclotrons which range in acceleration capabilities for deuterium ions from 16 to 50 MeV. The information developed over this range of energies allows comparison of the important clinical parameters and their variation with energy. Information is presented for a series of charged particle reactions which produce neutrons and the basic physics parameters of interest such as neutron yield, average and maximum neutron energy, and shielding considerations are discussed. For the reaction Be(d,n) the influence of charged particle energy on the above parameters is discussed and the reflection of this basic data in the measurements of clinical importance such as dose buildup in the first few millimeters (skin sparing), central axis depth dose, isodose distribution, and tumor control-complication rate relationships are considered. The conflicting criteria which must be considered in the design of any such facility for neutron therapy are reviewed, with the reader allowed to reach his own decision as to what the optimum design energy is.

25008 BASIC SAFETY STANDARDS FOR RADIATION PROTECTION. Dousset, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). APAVE Rev.; 56: No. 191, 50-55(Jul 1975). (In French)

A short review is made of the pathological effects of ionizing radiations. The basic safety standards for the various categories of persons likely to be exposed to radioactive radiation or materials are developed as well as their significance and the mind governing their application. (FR)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 23656, 24366, 24395, 24540, and 25045.

25009 (CONF-751209-21) KONDO EFFECT IN THE ANDERSON MODEL. Arai, T. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 6p. Dep. NTIS $3.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The Green's function solution of the Anderson model calculated by the functional derivative method developed earlier is shown to yield the density of states having the three-peak structure proposed by Gruner and Zawadowski where the central peak indeed introduces the lnT dependence. (auth)

25010 (ERDA-tr-114) SPATIAL NONUNIFORM CONDUCTIVITY AND FORCE-FREE MAGNETIC FIELDS. I. Gopasyuk, S. I. Translated from Izv. Krym. Astrofiz. Obs.; 41-42: (1970). 10p. Dep. NTIS $3.50.

The influence of non-uniform conductivity on the structure of a force-free magnetic field is examined. Using Maxwell's equations and Ohm's law it is shown that the magnetic field cannot be force-free if conductivity is non-uniform. There exists force-free configuration in the case of uniform conductivity. Assuming axial symmetry the general solution of the equation describing a force-free magnetic field is given. Both integrals for the equations of the lines of force have been found. This solution shows that the magnetic field decreases exponentially with height. (auth)

25011 (LA-UR-75-2424) STATE VECTOR LABELLING PROBLEM: A REVIEW OF STRUCTURAL PRINCIPLES. Louck, J. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1976. Contract W-7405-Eng-36. 40p. (CONF-760118-1). Dep. NTIS $4.00.

From symposium on mathematical physics; Mexico City, Mexico (5 Jan 1976).

The technique of labeling state vectors by use of the simultaneous eigenvalues of a complete set of commuting Hermitian operators stems from the early days of quantum theory. In sharp contrast to the classical method, there stands the nonorthogonal bases methods of Moshinsky and Bargmann and the null space methods of Biedenharn and Louck. The structural principles underlying these various methods are presented and discussed. 2 figures. (auth)

25012 (PP-444) SPACE-TIME SYMMETRIES IN RELATIVITY AND QUANTUM MECHANICS: NEW RESULTS. Recami, E.; Ziino, G. (Catania Univ. (Italy). Istituto di Fisica). Dec 1975. 13p. Dep. NTIS (US Sales Only) $3.50.

Some consequences of the space-time symmetries previously studied within extended relativity are exploited, and that study is improved. In particular, it is shown that relativity requires antiparticles to be formally associated to negative rest-masses (but to positive relativistic masses and energies, of course!). The physical and geometrical meaning of chirality, P_5, is derived, in such a context, and shown to be essentially connected with the inversion of a fifth axis (the rest-mass axis). In five dimensions, from the frame with all the (five) axes inverted, an observer would describe antimatter exactly as the initial (noninverted) observer would describe matter, and vice versa. By applying what precedes to relativistic quantum mechanics (e.g. to fermion fields and Dirac equations), one obtains—among the other—a "strong CPT theorem" (see the text): "under inversion of all the five axes x,y,z,t,m_0, not only physical laws (of mechanics and electromagnetism, at least) are covariant, but physical fields are even invariant." (auth)

25013 (PP-447) GENERALIZED THEORY OF PHYSICAL DIMENSIONS AND THE BLACK-BODY PROBLEM IN CLASSICAL AND QUANTAL PHYSICS. Recami, E.; Spitaleri, C. (Catania Univ. (Italy). Istituto di Fisica). Dec 1975. 11p. Dep. NTIS (US Sales Only) $3.50.

On the basis of dimension theory, the following are shown: The Rayleigh–Jeans formula does not belong to classical thermodynamics, since it was incorrectly derived. On the basis of the first principle of thermodynamics and of the wave model of radiation, it is not possible to go beyond Wien's law; and in classical physics, it is impossible to merge ondulatory with corpuscular thermodynamics, since an irreducible dichotomy exists between these two aspects. The above statements hold whatever the details of the assumed mathematical model may be. All authors who believed they were deriving a Planck-type equation within "classical physics" actually introduced some spurious hypotheses (i.e., a quantal assumption). (auth)

25014 APPROXIMATING VAP. Charzewski, C. V.; Dreizler, R. M. (Frankfurt Univ. (F.R. Germany)). pp 73-74 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (Eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The results of constrained Hartree–Fock calculations $\Phi\lambda$ are used to generate families of states of good angular momentum $P_J\Phi\lambda$. For the selection of optimal values λ_J minimization of both the projected energy E_p as well as the projected variance h_p^2 are considered and compared. (NL)

25015 HARTREE–FOCK AND THE GENERATOR COORDINATE METHODS IN FIELD THEORY. The Polaron Problem. Da Providencia, J.; Da Conceicao Ruivo, M.; De Sousa, C. A. (Coimbra Univ. (Portugal)). pp 23-24 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (Eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The Hartree–Fock (HF) and the Generator Coordinate Method (GCM) were developed in connection with the quantal discription of many-body systems. An investigation has been made of the usefulness of these methods when applied to problems in Field Theory. As an example the problem of the polaron is considered, i.e., the problem of the motion of an electron in a ionic crystal, in the strong coupling limit. (NL)

25016 BOSON HAMILTONIAN DERIVED FROM THE TIME-DEPENDENT HARTREE–FOCK FORMALISM. Giannoni, M. J. (Paris-11 Univ., 91 – Orsay (France). Div. de Physique Theorique). pp 39-40 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (Eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The purpose of the paper is to study the possibility of quantizing the exact TDHF energy by deriving the corresponding classical Hamilton equations. An interacting bosons Hamiltonian is obtained. (NL)

25017 VARIATIONAL DERIVATION OF THE ADIABATIC TIME-DEPENDENT HARTREE–FOCK FORMALISM. Brink, D. M. (Oxford Univ. (UK). Dept. of Theoretical Physics); Giannoni, M. J.; Veneroni, M. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). pp 25-26 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (Eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

A procedure is outlined for deriving the adiabatic time-dependent Hartree–Fock formalism based on the separate variation of χt and $\rho_0 t$ in the decomposition $\rho(t) = e^{i\chi t}\rho_0 t e^{-i\chi t}$. (NL)

25018 ADIABATIC AND NON-ADIABATIC TIME DEPENDENT HARTREE–FOCK THEORY WITH SKYRME INTERACTIONS. Brink, D. M.; Engel, Y. M.; Goeke, K. (Oxford Univ. (UK). Dept. of Theoretical Physics); Krieger, S. J. (Oxford Univ. (UK). Nuclear Physics Lab.); Vautherin, D. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). pp 27-28 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (Eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The Skyrme forces are included in the time dependent Hartree–Fock formalism along with the adiabatic approximation. The ATDHF equation can be transformed into a finite set of inhomogeneous linear differential equations. (NL)

25019 ITERATION METHOD FOR SOLVING THE ADIABATIC TIME-DEPENDENT HARTREE–FOCK EQUATIONS. Giannoni, M. J.; Vautherin, D.; Veneroni, M. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). pp 29 of Nuclear Self-Consistent Fields. Ripka, G.; Porneuf, M. (Eds.). Amsterdam; North-Holland Publishing Company (1975).

From proceedings of the international conference on nuclear self-consistent fields; Trieste, Italy (24 Feb 1975).

The ATDHF equations are presented in a form suitable for solution by an iterative procedure. The mass parameter so obtained contains the cranking formula as first term. (NL)

25020 SCHROEDINGER EQUATION DERIVED FROM A CONTINUOUS MODEL OF DIFFUSION. Fronteau, J. (Orleans

Univ., 45 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 281: No. 2, 123-126(21 Jul 1975). (In French)

The Schroedinger equation for stationary states is derived by perturbing Hamiltonian dynamics with a continuous diffusion term. (FR)

25021 POINTS OF BIFURCATION ALONG THE SEQUENCE OF ROTATING AXISYMMETRIC MASSES WITH MAGNETIC FIELDS. Kochhar, R. K. (Indian Inst. of Astrophysics, Bangalore). Pramana; 5: No. 5, 294-302(Nov 1975).

It is shown that the points of bifurcation belonging to the third harmonies along the sequence of Maclaurin spheroids viewed from an inertial frame are distinct from the corresponding points along the Maclaurin sequence considered stationary in a rotating frame and occur at eccentricity e = 0.73113 and e = 0.99608, the Maclaurin spheroids having become dynamically unstable before the second point is reached. A toroidal magnetic field leaves these points unaffected, while a general poloidal field may either raise or lower these points of bifurcation. (auth)

25022 DYNAMIC OBSERVATION MODELS. Schilder, M. (Cornell Univ., Ithaca, NY). J. Stat. Phys.; 13: No. 6, 491-514 (Dec 1975).

It is shown that radar and quantum mechanics may be modeled using the Kalman–Bucy state-equation observation approach. A method is given for realizing the optimal position filters. (auth)

25023 BOUNDS ON EIGENVALUES OF RELATED HAMILTONIAN OPERATORS. Aly, H. H.; Hill, R. C. (Southern Illinois Univ., Edwardsville). Nuovo Cim.; 31B: No. 1, 120-128 (11 Jan 1976).

A theorem is presented which allows one to obtain a bound on the ground-state eigenvalue of an operator equation, given the eigenvalue of another related equation. The equations are related by the "potential" in one equation being the square of the "potential" in the other. The theorem is related to the Ritz variational principle, but allows one to obtain the bound without having to integrate a trial function. Some examples are given of the application of this theorem to the Schroedinger equation. (auth)

25024 DISCRETE SUBGROUPS OF THE LORENTZ GROUP. Schwarz, F. (Univ., Kaiserslautern, Ger.). Lett. Nuovo Cim.; 15: No. 1, 7-14(3 Jan 1976).

It is pointed out that a partial answer to the question of whether there exist still more discrete subgroups of the Lorentz group and how to find them can be obtained from the theory of automorphic functions of one complex variable. (JFP)

25025 CLASSICAL LIMIT OF QUANTUM MECHANICS. Siegel, W. (Jagellonian Univ., Krakow). Acta Phys. Pol., Ser. B7: No. 1, 29-38(Jan 1976).

The classical limit of nonrelativistic quantum mechanics in the Wigner phase-space formalism is discussed. It appears that the limit of an eigenstate is represented by a singular probability density concentrated and constant on subsets of phase space corresponding to the given value of the observable. The limit of eigenstates of energy is investigated as an example. (auth)

Quantum Field Theories

Refer also to abstracts 24442, 24448, 24468, 24482, 24609, 25015, and 25080.

25026 (CONF-741181-P1, pp 203-219) ANALOGY BETWEEN CLASSICAL AND QUANTUM MECHANICS. Mukunda, N. (Indian Inst. of Sciences, Bangalore). 1974.

From 2nd high energy physics symposium; Visva-Bharati, Santiniketan, India (9 Nov 1974).

In proceedings of the II high energy physics symposium. (Department of Atomic Energy, Bombay (India)).

The discussion of fundamental length includes fundamental length in quantum electrodynamics, quantization of length, and fundamental length in nonpolynomial theory. (JFP)

25027 (DESY-75/44) DUALITY IN QUANTUM FIELD THEORY. Mack, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nov 1975. 16p. Dep. NTIS (US Sales Only) $3.50.

Theses are formulated to the effect that local quantum field theory has a dual structure. The theses are based on experience with conformal invariant quantum field theory. (auth)

25028 (DESY-75/45) OPERATOR PRODUCT EXPANSIONS ON THE VACUUM IN CONFORMAL QUANTUM FIELD THEORY IN TWO SPACETIME DIMENSIONS. Luescher, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nov 1975. 54p. Dep. NTIS (US Sales Only) $4.50.

Let $\varphi_1(x)$ and $\varphi_2(y)$ two local fields in a conformal quantum field theory (CQFT) in two dimensional spacetime. It is then shown that the vector-valued distribution $\varphi_1(x)\varphi_2(y)|0\rangle$ is a boundary value of a vector-valued holomorphic function which is defined on a large conformally invariant domain. By group theoretical arguments alone it is proved that $\varphi_1(x)\varphi_2(y)|0\rangle$ can be expanded into conformal partial waves. These have all the properties of a global version of Wilson's operator product expansions when applied to the vacuum state $|0\rangle$. Finally, the corresponding calculations are carried out more explicitly in the Thirring model. A complete set of local conformally covariant fields is found, which is closed under vacuum expansion of any two of its elements (a vacuum expansion is an operator product expansion applied to the vacuum). (auth)

25029 TESTS OF SUM RULES FOR PHOTON TOTAL CROSS SECTIONS IN QUANTUM ELECTRODYNAMICS AND MESODYNAMICS. Gerasimov, S. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Moulin, J. (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). Nucl. Phys., B; 98: No. 2, 349-364(3 Nov 1975).

Sum rules for photon-hadron, photon-lepton and photon-photon total cross sections are tested using the perturbative methods of quantum electrodynamics and mesodynamics. Some possible modifications of the investigated sum rules are pointed out and discussed. Arguments are provided which support the validity of the Cabibbo–Radicati sum rule to all orders of the strong coupling constant in the "chiral" limit of a vanishing pion mass. (NL)

25030 ULTRAVIOLET ASYMPTOTICS OF THE GREEN AND VERTEX FUNCTIONS IN SUPERGAUGE INVARIANT FIELD THEORY. Fradkin, E. S.; Kalashnikov, O. K. (AN SSSR, Moscow. Fizicheskij Inst.). Nucl. Phys., B; 98: No. 2, 259-266 (3 Nov 1975).

Ultraviolet asymptotics of the Green and vertex functions in supergauge invariant field theory for the SU(N) group is established. Renormalization of the gauge field coupling constant is calculated and the condition for asymptotic freedom is found. (NL)

25031 CONFORMALLY INVARIANT SOLUTIONS OF QUANTUM FIELD THEORY EQUATIONS. I. Fradkin, E. S. (AN SSSR, Moscow). Nucl. Phys., B; 99: No. 2, 317-345(24 Nov 1975).

The extract conformally-invariant solution of renormalized quantum field theory equations is considered. Dynamical equations form an infinite system of equations for vertices. This system does not determine the vertices uniquely; it must be supplemented by axiomatic requirements (locality, crossing symmetry etc). The latter were not taken into consideration in the course of the solution of equations, therefore the solution obtained contains a number of arbitrary functions. The role of the mentioned requirements for the construction of the unique solution is discussed. The vertices are considered, containing conserved external lines (the current and the energy-momentum tensor). It is shown that the generalized Ward identity makes it possible to obtain these vertices explicitly up to an arbitrary transverse part. (NL)

25032 COMPACT GAUGE FIELDS AND THE INFRARED CATASTROPHE. Polyakov, A. M. (AN SSSR, Moscow. Inst. Teoreticheskoj Fiziki). Phys. Lett., B; 59: No. 1, 82-84(13 Oct 1975).

It is shown that infrared phenomena in the gauge theories are guided by certain classical solutions of the Yang–Mills equations. The existence of such solutions can lead to finite correlation length which stops infrared catastrophe. Only theories with a compact but abelian gauge group are dealt with. In this case the problems of correlation length and charge confinement are completely solved. (NL)

25033 PSEUDOPARTICLE SOLUTIONS OF THE YANG–MILLS EQUATIONS. Belavin, A. A.; Polyakov, A. M.; Schwartz, A. S.; Tyupkin, Yu. S. (AN SSSR, Moscow. Inst. Teoreticheskoj Fiziki). Phys. Lett., B; 59: No. 1, 85-87(13 Oct 1975).

Regular solutions of the four dimensional euclidean Yang–Mills equations are found. The solutions minimize locally the action integrals which is finite in this case. The topological nature of the solutions is discussed. (NL)

25034 EXISTENCE OF THE :exp phi:$_4$ QUANTUM FIELD THEORY IN A FINITE VOLUME. Heifets, E. P. (AN SSSR, Novosibirsk. Inst. Matematiki). Phys. Lett., B; 59: No. 1, 61-62(13 Oct 1975).

The quantum field theory with an exponential interaction in the four-dimensional space-time in a periodic box is considered.

It is shown that the vacuum expectation values exist as tempered distributions and satisfy some Wightman axioms. (NL)

25035 PROJECTION OPERATORS AND SUPPLEMENTARY CONDITIONS FOR SUPERFIELDS WITH ARBITARY SPIN. Sokatchev, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Nucl. Phys., B; 99: No. 1, 96-108(17 Nov 1975).

It is shown that a superfield with an external spin j and a non-vanishing mass contains four irreducible representations of the supersymmetry algebra. A general method is proposed for extracting these irreducible multiplets out of the superfield using projection operators constructed with the help of Casimir operators. The same decomposition is expressed in terms of supplementary differential conditions. (NL)

25036 ADIABATIC DILATIONS AND ESSENTIAL REGGE SPECTRUM. Lovelace, C. (Rutgers—the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., B; 99: No. 1, 109-149(17 Nov 1975).

Adiabatic perturbation theory works for non-conserved dilation operators. At each effective coupling, all renormalization group functions are dilation eigenvalues of a "tangent" field theory, which preserves scale invariance instead of translation invariance. The adiabatic expansion reconstructs the true field theory from this tangent bundle. For complex angular momentum, the short and long distance expansions mix indecomposably at certain turning points. By connecting the UV and IR limits across them, the adiabatic method determines Regge intercepts from integrals over the renormalization group. Fixed Regge cuts or accumulations of poles are insensitive to the IR region. (NL)

25037 ASYMPTOTIC FREEDOM, INFRARED CONVERGENCE AND SUPERSYMMETRY. Browne, S.; O'Raifeartaigh, L.; Sherry, T. (Dublin Inst. for Advanced Studies (Ireland)). Nucl. Phys., B; 99: No. 1, 150-166(17 Nov 1975).

The conditions for infrared convergence and asymptotic freedom are investigated for a system in which (in order to produce a spontaneous breakdown) a supersymmetric matter-matter interaction is added to the supersymmetric Yang–Mills Lagrangian. It is found that, in contrast to conventional theory, the conditions imposed by the asymptotic freedom of the matter-matter interaction are not stringent, and are automatically satisfied for adjoint representation. The conditions for infrared convergence are also not too stringent. However the joint conditions for asymptotic freedom and infrared convergence turn out to be quite stringent. Nevertheless, a model is proposed which, subject to some reservations, appears to satisfy the joint conditions. (NL)

25038 GEOMETRIC MEANING OF MANDELSTAM'S PATH DEPENDENT QUANTITIES. Chi, C.; Nhuong, D. (Inst. of Physics, Hanoi, Viet Nam). Acta Phys. Pol., Ser.; B7: No. 1, 11-16(Jan 1976).

By using the theory of fiber bundle, the path dependent quantities used by Mandelstam to derive the Feynman rules for the Yang–Mills and gravitational fields are shown to be just the quantities taken on a horizontal path of a fiber space. This geometric meaning enables one to construct new path dependent quantities remaining unchanged under gauge transformations. (auth)

25039 CONNECTION BETWEEN THE ELECTRON PROPAGATOR AND THE BAKER–JOHNSON FUNCTION IN CONFORMAL INVARIANT QUANTUM ELECTRODYNAMICS. Fry, M. P. (Univ., Tuebingen, Ger.). Nuovo Cim.; 31A: No. 1, 129-150(1 Jan 1976).

The single-electron-line electron propagator of massless quantum electrodynamics is shown to be determined by the product of the Baker–Johnson function F_1 and the sum $E_1 + E_2$ of coefficients appearing in the first two terms of the $C = -1$, $J = 1$ part of the Wilson expansion of the product $\psi(x)\bar{\psi}(y)$ of electron fields. This statement is subject to the restriction that E_1 and E_2 are calculated in a special gauge in which massless quantum electrodynamics without electron creation and annihilation is conformal invariant. The possibility of determining the analyticity properties in the coupling constant of the product $(E_1 + E_2)\,F_1$ from the propagator for an electron in a path-dependent field is discussed. (auth)

25040 CONVOLUTION REGULARIZATION IN QUANTUM ELECTRODYNAMICS. Lopez, C. A. (Univ. of Chile, Santiago). Nuovo Cim.; 31A: No. 1, 54-64(1 Jan 1976).

The divergent graphs of quantum electrodynamics and interpretation of the undefined products of two or more propagators are considered as follows: one first modifies the argument of one propagator by adding a small spacelike four-vector of magnitude ϵ; one then computes the integral and average the resulting expression over all angles and, finally, take the limit $\epsilon = 0$. In momentum space each diagram turns into the Fourier transform of the usual integrand. The computation of any loop reduces to simple iterated convolution products of the causal delta $\Delta_c(\epsilon)$ by itself. The procedure is fully covariant and the Ward identity is satisfied for all ϵ; however it is not gauge invariant, not even in the limit $\epsilon = 0$. This invariance may be recovered a posteriori by renormalizing the photon mass to zero. To show how easily the method works, the electron self-energy diagram in lowest order is explicitly evaluated. The result coincides exactly with the conventional way of handling infinite integrals, both for the finite part and for the ultraviolet and infrared divergences. Feynman's auxiliarly mass M turns out to be inversely proportional to ϵ. (auth)

25041 NOTION OF EQUIVALENT MOVING FRAMES. Ryff, L. C. B. (Univ., Rio de Janeiro). Nuovo Cim.; 30B: No. 2, 390-401(11 Dec 1975).

A principle of kinematical relativity is introduced and some consequences are derived. A group of transformations having Poincaré transformations as a special case is obtained for any kind of motion. A moving particle is shown to satisfy a variational "principle." Rotating frames are seen not to be "good" frames, and the clock hypothesis to be valid only for uniform rectilinear motion. Two space-time dimension transformations are discussed with further details. (auth)

25042 DESCRIPTION OF A ROD WITH RIGID, HYPERBOLIC MOTION IN THE SYNCHRONOUS AND THE ASYNCRONOUS FORMULATION OF RELATIVISTIC DYNAMICS. Gron, O. Nuovo Cim.; 30B: No. 2, 313-324(11 Dec 1975).

The synchronous and the asynchronous descriptions of a rod with rigid hyperbolic motion are compared. It is shown that the covariant description, employing the energy–momentum four-vector, has an asynchronous character. The conclusion is, that in describing extended systems moving not too far from rigidity, the asynchronous formulation is more adequate than the synchronous formulation. (auth)

25043 NONPOSITIVITY OF THE DIAGONAL COHERENT-STATE REPRESENTATION. Leyland, P. (Univ., Nice). Nuovo Cim.; 31B: No. 1, 32-40(11 Jan 1976).

The definition of the P-representation for certain normal states of the C*-algebra of the CCR and its consequences for a finite and an infinite number of degrees of freedom is studied. It is explicitly shown that the weight function appearing in the integral representation of the finite-dimensional density matrix can take negative values on sets of nonzero measure. For the infinite system, a probabilistic interpretation of normal states imposes consistency conditions on the family of finite-dimensional density matrices, which do not, in general, eliminate the nonpositivity of these weight functions. (auth)

25044 SCALAR FIELD AND WEYL GEOMETRY. Rothwell, P. L. (Cambridge Research Labs., Bedford, MA). Nuovo Cim.; 30B: No. 2, 267-279(11 Dec 1975).

Following Bergmann the internal consistency of Weyl geometry is examined. It is concluded, because of the requirement of Weyl gauge invariance, that a consistent macroscopic application of Weyl geometry is not possible. At the particle level a first-order action is constructed that combines Weyl geometry with the scalar field. Under the assumption that this action describes a closed system, the Weyl vector ψ_α is equated with the dynamical variable φ_α of the scalar field. In addition to constraint equations, the Einstein equation is also derived. This equation can be reformulated in a Riemannian-equivalent form with a different stress tensor. The requirement that the corresponding stress tensors must satisfy the Bianchi identities in their respective spaces leads to a Weyl gauge condition. In the Weyl picture the field variable φ has the geometrical interpretation of defining the relative unit of length at each point of the Weyl space. A direct implication of a Weyl particle geometry is that the rest mass of a probe scattering particle will be position dependent inside the target (scalar) particle. It is found that $m^2(x^\mu) = m_0^2/(1 + (B/A)\varphi)^4$, where B, A are constants and φ is the scalar-field value at x^μ. (auth)

25045 LAGRANGIAN AND HAMILTONIAN FORMALISMS: AN ANALYSIS OF CLASSICAL MECHANICS ON TANGENT AND COTANGENT BUNDLES. Caratu, G.; Marmo, G.; Simoni, A.; Vitale, B.; Zaccaria, F. (Univ., Naples). Nuovo Cim.; 31B: No. 1, 152-172(11 Jan 1976).

The notion of dynamical system in classical mechanics is built starting from the trajectories on the configuration space. Classes of equivalent vector fields on tangent and cotangent bundles are obtained. This leads to a re-examination in detail of the meaning of the Hamiltonian and Lagrangian functions. (auth)

25046 FALLACY OF PERTURBATIVE METHODS FOR HIGHER-SPIN EQUATIONS. Velo, G.; Zwanziger, D. (New York Univ., NY). Lett. Nuovo Cim.; 15: No. 2, 39-40(10 Jan 1976).

The problem of constructing a quantum field theory out of a higher-spin classical field theory in the presence of interactions is treated. It is pointed out that there are essential features of the theory which are missing in the perturbative solution. In particular, although the perturbation solution is causal in every order, the exact solution, if it exists, is noncausal. It is concluded that perturbation theory is entirely misleading in determining the compatibility of higher-spin equations with the postulates of special relativity. (JFP)

25047 LAGRANGE FORMULATION OF THE 20-COMPONENT THEORY OF SPIN-3 FIELDS. Kawasaki, M.; Kobayashi, M.; Mori, Y. (Gifu Univ., Japan). Lett. Nuovo Cim.; 14: No. 17, 611-614(27 Dec 1975).

It is shown that the Lagrange formulation of the 20-component theory of massive spin-3 fields (mass m) encounters an undesirable feature: the description of spin-3 fields by the symmetrical tensor of rank 3 belonging to the representation $(^3/_2, ^3/_2) + (^1/_2, ^1/_2)$ is impossible and requires an auxiliary field in order to derive all of the subsidiary conditions. The Takahashi-Umezawa prescription for the system with spin 2S + 1 (S = 1) suffers from the fact that an auxiliary field must be introduced. (JFP)

25048 TRANSVERSE MOMENTUM CUTOFF IN A REGGEON FIELD THEORY. Wallace, J. San Diego; Univ. of California (1975). 90p. University Microfilms Order No. 76-2321.

Thesis (Ph. D.).

A modified version of the Reggeon field theory is presented. By introducing a momentum cutoff, one can eliminate the ultraviolet divergencies from the theory. By further incorporating a "bare" pomeron into the k^2-cutoff theory, one avoids the infrared divergence found in the Reggeon field theory. Consequently, one can work directly at the physical dimension of the space and avoid the 4-D expansion. The theory confirms most of the results found in the Reggeon field theory. (Diss. Abstr. Int., B)

25049 AFFINE PROPERTIES OF THE LIGHT CONE AND THEIR APPLICATION IN THE QUANTUM ELECTRODYNAMICS. Staruszkiewicz, A. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Acta Phys. Pol., Ser. B; 4: 57-63(1973).

It is shown that there exists on the light cone an affine connection which is metric, semisymmetric and totally integrable. The connection is used to displace parallelly polarization vectors of the photon; a new gauge for the electromagnetic field is thus introduced and the commutator of two potentials in the new gauge is calculated. The commutator is invariant with respect to the four-parameter group which leaves invariant a fixed null direction. (auth)

25050 NONLOCAL QUANTUM ELECTRODYNAMICS. Tran Hu'u Phat (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Acta Phys. Pol., Ser. B; 4: 311-328(1973).

In this paper nonlocal quantum electrodynamics is constructed satisfactorily. The theory is free of ultraviolet infinities, its S-matrix is macrocausal, unitary on the mass shell and fulfils gauge invariance. (auth)

25051 QUANTUM ELECTRODYNAMICS WITHOUT ULTRAVIOLET INFINITIES. Tran Hu'u Phat (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Acta Phys. Pol., Ser. B; 4: 329-346(1973).

Quantum electrodynamics without ultraviolet infinities is constructed satisfactorily. The cosmic field, discovered earlier, is utilized as the regularized field of the theory. The mechanism of violation of the scale invariance principle is outlined for the first time. In the second order of the perturbation theory the corrections for mass and charge of electron are obtained as follows: $\delta m/m = 3\alpha/4\pi \ln (1/lm)^2 + O((lm)^2 \ln (lm)^2)$, $\delta e/e = \alpha/6\pi \ln (1/lm)^2 + O((lm)^2 \ln (lm)^2)$. The procedure for securing the gauge invariance of the theory is established. The problem of the equivalence theorem is discussed. Finally the system of equations for propagators of electron and photon is obtained and the physical meaning of the two renormalization constants Z and Z_1 is discussed. (auth)

25052 QUANTIZATION OF YANG-MILLS AND GRAVITATIONAL FIELDS. Chi, C. (Inst. of Physics, Hanoi, Viet-Nam). Acta Phys. Pol., Ser. B; B7: No. 1, 3-9(Jan 1976).

An approach to the quantization problem of gauge fields, based on the external source method combined with the quantum dynamical equation, is presented. (auth)

25053 ELEMENTARY PARTICLES IN A CURVED SPACE. III. Fronsdal, C. (Department of Physics, University of California, Los Angeles, California 90024); Haugen, R.B. Phys. Rev. D 12: No. 12, 3810-3818 (15 Dec 1975).

Irreducible representations of the 3 + 2 de Sitter group are associated with free Dirac fields in a space of constant, positive curvature. (auth)

25054 ELEMENTARY PARTICLES IN A CURVED SPACE. IV. MASSLESS PARTICLES. Fronsdal, C. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 12: No. 12, 3819-3830 (15 Dec 1975).

If physics is stable with respect to a class of perturbation of the spacetime metric, including that of "small" constant four-dimensional curvature, then it may be shown that (1) left-handed and right-handed neutrinos are distinguished by a superselection rule; (2) magnetic monopoles cannot exist; (3) the conformal symmetry associated with the field equations for massless particles with spin 0, 1/2, and 1 is spontaneously broken—except in the case of neutrinos with fixed chirality. (auth)

25055 ELECTROMAGNETIC INTERACTION IN THE BONNOR-MOFFAT-BOAL UNIFIED FIELD THEORY. Johnson, C.R. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). Phys. Rev. D 12: No. 12, 3831-3834 (15 Dec 1975).

Recently Moffat and Boal proposed a unified field theory of electromagnetism and gravitation. The theory is based on a nonsymmetric tensor field $g_{\mu\nu}$. The field equations of the theory are identical to those proposed by Bonnor some years ago in a modification of Einstein's unified field theory, but Moffat and Boal interpret the field $g_{\mu\nu}$ in a different way from Bonnor and represent particles by singularities of a particular type. In this paper we show, using a fast-motion approximation procedure, that charged particles in the new theory interact in the lowest nontrivial order of approximation through the complete laws of classical electrodynamics—Maxwell's equations for the electric and magnetic fields, the Lorentz force, and the radiation-reaction force acting on the particles. (auth)

25056 SOME REMARKS ABOUT UNQUANTIZED NON-ABELIAN GAUGE FIELDS. Wu, T.T. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138); Yang, C.N. Phys. Rev. D 12: No. 12, 3843-3844 (15 Dec 1975).

For unquantized non-Abelian gauge fields, remarks are made on the question of whether the field strengths determine the gauge field, on the dual transformations, and on complex gauge fields. (auth)

25057 CONCEPT OF NONINTEGRABLE PHASE FACTORS AND GLOBAL FORMULATION OF GAUGE FIELDS. Wu, T.T. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138); Yang, C.N. Phys. Rev. D 12: No. 12, 3845-3857 (15 Dec 1975).

Through an examination of the Bohm-Aharonov experiment an intrinsic and complete description of electromagnetism in a space-time region is formulated in terms of a nonintegrable phase factor. This concept, in its global ramifications, is studied through an examination of Dirac's magnetic monopole field. Generalizations to non-Abelian groups are carried out, and result in identification with the mathematical concept of connections on principal fiber bundles. (auth)

25058 QUANTUM THEORY OF ČERENKOV RADIATION IN A UNIAXIAL CRYSTAL. Kong, J.A. (Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 12: No. 12, 3858-3860 (15 Dec 1975).

The quantum theory of Čerenkov radiation caused by a Dirac particle in a uniaxial crystal is developed in the context of phenomenological quantum electrodynamics. Using time-dependent perturbation theory, the transition probability per unit time and the total energy of the radiated extraordinary photons are determined. (auth)

25059 DIMENSIONAL REGULARIZATION AND MASS SINGULARITIES. Marciano, W.J. (Department of Physics, Rockefeller University, New York, New York 10021). Phys. Rev. D 12: No. 12, 3861-3871 (15 Dec 1975).

We demonstrate how the continuous-dimension method can be employed to simultaneously regularize infrared photonic divergences and electron mass singularities (i.e., terms which diverge in the limit $m_e \to 0$). Using this technique, a photon mass need not be introduced and the electron mass can be set equal to zero from the start, thereby simplifying radiative-corrections calculations. Transition rates obtained in this approach are functions of the regularizing parameter n (the dimension of space-time). To determine which of these rates are finite in the limit $n \to 4$, we employ the theorem on the cancellation of mass singularities. Even for transition rates which contain residual mass singularities, this method is useful for extracting leading logarithmic corrections. The formalism of this approach is illustrated for the decay of a charged intermediate vector boson. (auth)

25060 KLEIN-GORDON EQUATION WITH DISCONTINUOUS MASS: AN INSTRUCTIVE NONLINEAR CLASSICAL FIELD

THEORY. Kazama, Y.; Goldhaber, A.S. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. D 12: No. 12, 3872-3879 (15 Dec 1975).

The Klein-Gordon equation with a discontinuous field-dependent mass term provides an example of a simple nonlinear classical field theory. This theory is studied to determine if it exhibits a behavior hypothesized in a recently proposed picture of multimeson production. As expected, it turns out that (with a small additional decay term in the equation) the space-time average of the field strength generated by a δ-function source can be made insensitive to the source strength, once it exceeds a certain threshold. When two space-time-separated δ-function sources are present, their independence (or dependence) in producing slow mesons is determined by the ratio of decay time to source separation. If the mass in the region of low field strength is imaginary, then there are stable sourceless "kink" solutions in one space dimension. (auth)

25061 QUANTIZATION OF THE LOCALIZED SOLUTIONS IN TWO-DIMENSIONAL FIELD THEORIES OF MASSIVE FERMIONS. Lee, S.Y.; Gavrielides, A. (Department of Physics, Purdue University, Lafayette, Indiana 47907). Phys. Rev. D 12: No. 12, 3880-3886 (15 Dec 1975).

Using the semiclassical functional method developed by Dashen, Hasslacher, and Neveu, the classical localized solutions for the bound states of massive fermions in two-dimensional field theories are quantized. The mass spectra of the bound states are then obtained. For the massive Gross-Neveu model, the mass spectrum agrees with what has been found by Dashen *et al.* for the massless Gross-Neveu model where fermions acquire mass through dynamical symmetry breaking. For a theory of massive fermions with scalar as well as pseudoscalar Fermi interactions, the mass spectrum is found to be very similar to that for the doublet in the sine-Gordon equation. In fact, under certain conditions they become identical. (auth)

25062 NEW TREATMENT OF THE BOUND-STATE PROBLEM IN QUANTUM FIELD THEORY. Partovi, M.H. (Department of Physics, Arya-Mehr University, Tehran, Iran,). Phys. Rev. D 12: No. 12, 3887-3896 (15 Dec 1975).

A new formalism for the description of the two-body system and well suited to the bound-state problem is developed within the context of quantum electrodynamics. The resulting two-body equation is a two-time, covariant, functional-differential one which, in the center-of-mass frame, reduces to a single-time, Schrödinger-type equation. Application of this equation is illustrated by calculating several known recoil and structure corrections to the energy levels of positronium and hydrogen. Further extensions and applications of the formalism are discussed. (auth)

25063 GAUGE-INVARIANT WILSON OPERATORS AND RADIATIVE CORRECTIONS TO HADRONS. Frenkel, J. (Instituto de Fisica, Universidade de São Paulo, São Paulo, Brasil). Phys. Rev. D 12: No. 12, 3963-3968 (15 Dec 1975).

We discuss the renormalization of Wilson operators, which are relevant for the radiative corrections to hadrons, in covariant Lorentz gauges, for a class of non-Abelian gauge theories. We find for the anomalous dimensions of the operators, which determine the asymptotic behavior of the radiative corrections, the same gauge-invariant result as the one obtained in ghost-free gauges. (auth)

25064 IMPOSSIBILITY OF SPONTANEOUSLY BREAKING LOCAL SYMMETRIES. Elitzur, S. (Department of Physics & Astronomy, Tel Aviv University, Tel Aviv, Israel). Phys. Rev. D 12: No. 12, 3978-3982 (15 Dec 1975).

It is argued that a spontaneous breaking of local symmetry for a symmetrical gauge theory without gauge fixing is impossible. The argument is demonstrated in a simple system of Abelian gauge fields on a lattice. (auth)

25065 DOMAIN STRUCTURE OF A REGGEON FIELD THEORY WITH THREE COUPLINGS. Geer, K.A.; Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 12: No. 12, 3996-4000 (15 Dec 1975).

The high-energy behavior of a Reggeon field theory with a three-Reggeon coupling and two four-Reggeon couplings is considered. Using the renormalization-group equations which are calculated in lowest order by Bardeen *et al.* for this model, we study the way the couplings evolve to the fixed points in the high-energy limit. We find that there are three fixed points (plus a fourth at infinity) to which the couplings can evolve. The space of couplings divides into four domains, two of which are two-dimensional and two of which are three-dimensional. The couplings in one of the three-dimensional domains are found to evolve to infinity and the couplings in the other three domains are found to evolve to the fixed-point couplings. We show the boundaries of these domains and some characteristic evolution curves. The implications of the domain structure of the model are discussed. (auth)

25066 ENERGY EIGENVALUES FOR A CHARGED SPIN-1/2 PARTICLE IN A HOMOGENEOUS MAGNETIC FIELD. Weaver, D.L. (Department of Physics, Tufts University, Medford, Massachusetts 02155). Phys. Rev. D 12: No. 12, 4001-4002 (15 Dec 1975).

The exact energy eigenvalues of a Dirac particle with anomalous magnetic moment are obtained in a constant, external magnetic field. (auth)

25067 RAPIDITY AMPLITUDES AND THEIR FOURIER TRANSFORMS. Durand, B. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706); O'Raifeartaigh, L. Phys. Rev. D 13: No. 1, 99-103 (1 Jan 1976).

Use of the rapidity y as a parameter in high-energy multiparticle scattering appears to be natural. In this note we point out that since y is a longitudinal boost angle, it has a natural canonical conjugate variable, namely the boost operator K_3 in the longitudinal direction, and that the eigenvalue k_3 of K_3, unlike y, is an additive quantum number. Hence it might be useful to expand the scattering amplitude in either y or k_3. A field theory in y or k_3 space is developed in which simplicities in y can be translated into coordinate space, through the relationship between k_3 and z. The invariant inclusive cross section, which is known to be a simple function of y, is related to the field number operator. This gives us a way of distinguishing in principle between different coordinate-space properties of particle production. (auth)

25068 SOLITONLIKE SOLUTIONS FOR A HIGGS SCALAR FIELD. Kudryavtsev, A.E. (Institute of Theoretical and Experimental Physics). JETP Lett. 22: No. 3, 82-83 (5 Aug 1975).

The interaction of two solitons is investigated in a two-dimensional classical scalar-field theory described by the Landau-Ginzburg equation. It is shown that a new solution (a double soliton) is formed and that the solution is self-localized, weakly oscillating, and weakly damped. (auth)

25069 TOPOLOGICALLY NONTRIVIAL PARTICLES IN QUANTUM FIELD THEORY. Tyupkin, Yu.S.; Fateev, V.A.; Shvarts, A.S. (Moscow Engineering-Physics Institute). JETP Lett. 22: No. 3, 88-89 (5 Aug 1975).

We establish the existence of unusual ("topologically nontrivial") particles in two-dimensional models in a situation wherein there are no solitons in the corresponding classical problem (in particular, for the $\lambda\phi^4$ and $g\bar{\psi}\psi\phi$ interactions at large λ and small g). (auth)

Gravitation and General Relativity

Refer also to abstracts 23994, 24510, and 25038.

25070 (IC-75/116) GRAVITY IN THE RAY GAUGE. Aragone, C. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1975. 13p. (CONF-750734-2). Dep. NTIS (US Sales Only) $3.50.

From meeting on the recent progress of the fundamentals of general relativity miramare; Trieste, Italy (7 Jul 1975).

Linearized gravity in the null-plane coordinates pure gravity in the ray gauge, gravity coupled to matter, and gravitational fields with vanishing null energy density and the spin coefficient approach are considered. (auth)

25071 (IC-75/136) GENERAL RELATIVISTIC EFFECTS IN BINARY SYSTEMS. Barker, B. M.; O'Connell, R. F. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1975. 25p. (CONF-750744-3). Dep. NTIS (US Sales Only) $3.50.

From meeting of physics and astrophysics of neutron stars and black holes; Varenna, Italy (14 Jul 1975).

Recently a rigorous derivation of the gravitational two-body equations of motion for arbitrary masses, spins and quadrupole moments. Here, one considers some new aspects of this work and, in addition, the detailed application of the results to binary stellar systems. First, one presents a heuristic classical derivation of results, for the purpose of giving a better physical insight into their nature. Next, one writes down general results, for the precession of the spin and the precession of the orbit, in terms of measurable quantities, for ready application to binary systems. In particular, a detailed analysis of the pulsar PSR 1913+16, and its companion is carried out. (auth)

25072 CYLINDRICALLY SYMMETRIC MATTER DISTRIBUTION WITH A MAGNETIC FIELD IN EINSTEIN–CARTAN THEORY. Prasanna, A. R. (Univ., Bonn). Pramana; 5: No. 5, 289-293 (Nov 1975).

Earlier studies of solutions of Einstein–Cartan equations have been extended to the case where a magnetic field co-exists with the matter distribution. An exact solution of Einstein–Cartan–Maxwell equations has been obtained representing a static cylinder of perfect fluid with an axial magnetic field H and a nonzero spin density K, satisfying the equation of state $\rho = \gamma\,(p_r + p_z - H^2/4\pi)$, γ being a constant. It is noticed that, as a consequence of field equations, there exists a direct relation between the pressure p,

and the spin density K, indicating that an increase in pressure would enormously increase the spin density. (auth)

25073 GEODESIC MOTION IN THE TOMIMATSU–SATO SPACE–TIMES. Calvani, M. (Univ., Padua); Catenacci, R. Nuovo Cim.; 31B: No. 1, 41-52(11 Jan 1976).

Axial and equatorial geodesics in the T-S space–times with a > m are studied. It is found that except in the Kerr case, all the singularities are invisible from infinity even if no horizon exists. Also causality violation and some observational properties of a naked (non-Kerr) spinning singularity are discussed. (auth)

25074 RELATIVITY, GRAVITATION, AND ABSOLUTE TIME. Wegener, M.; Ohrstrom, P. (Univ. of Aarhus, Denmark). Nuovo Cim.; 30B: No. 2, 291-298(11 Dec 1975).

The starting point is a variational equation based on a Lagrangian which is only a slight modification of the usual one of the STR. When interpreted with reference to an absolute time and a flat space, this equation immediately gives the correct advancement of the perihelion of a planet and a gravitational red-shift of the same magnitude as that observed. If one takes the red shift to be equivalent to a gravitational reduction of light velocity and rewrites the equation, it also yields the usual value of the deflection of light. One has thus derived the three so-called crucial effects of the GTR from a few simple assumptions. (auth)

25075 INVESTIGATION OF A GAGE THEORY IN GENERAL RELATIVITY. Stephenson, L. G. Norman, OK; Univ. of Oklahoma (1975). 103p. University Microfilms Order No. 76-3134. Thesis (Ph. D.).

The proposition is considered that a physical theory which prescribes a metric via a set of field equations is incomplete unless accompanying these field equations there is some prescription as to how lengths and times at different events are to be compared. It is then assumed that Einstein's field equations hold in a gauge other than the customary one. Several equations for this gauge are then proposed and by coupling these gauge equations with the field equations several problems in relativity and cosmology are investigated. In two of the problems investigated in relativity, the gravitational shift in spectral lines and radar echo delay, it is shown that this noncustomary gauge theory yields results which are "sensibly" different than those obtained from the ordinary Einstein theory. One model in cosmology (a static noncustomary universe) is also investigated, and it is shown for this case that the noncustomary gauge theory predicts results which are compatible with observed phenomena. (Diss. Abstr. Int., B)

25076 IMBEDDING METHOD OF FINDING THE MAXIMAL EXTENSIONS OF SOLUTIONS OF EINSTEIN FIELD EQUATIONS. Plazowski, J. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Acta Phys. Pol., Ser. B; 4: 48-56(1973).

The problem of obtaining the maximal analytic extension of the solution of Einstein field equations is investigated. We propose a method of finding the maximal analytic extensions by imbedding the corresponding manifolds into a pseudoeuclidean space. The method is demonstrated for the Schwarzschild-like, Reissner-Nordstrom and Kerr solutions. All extensions which we obtain are maximal. We believe that the simplicity of the method will make it useful in physical applications. (auth)

25077 UNIFIED GEOMETRY OF INTERNAL SPACE WITH SPACE-TIME. Cho, Y.M. (The Enrico Fermi Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637); Jang, P.S. Phys. Rev. D 12: No. 12, 3789-3792 (15 Dec 1975).

The unified theory of gravitation with gauge fields proposed earlier is shown to be a $(4 + n)$ -dimensional Einstein theory with n linearly independent complete spacelike Killing vector fields which span an n-dimensional metric submanifold and form a closed Lie algebra. In this picture the internal space is combined with space-time and the internal symmetry becomes a symmetry of the metric of the $(4 + n)$ -dimensional combined space. The 4-dimensional space-time appears as the quotient space of the $(4 + n)$ -dimensional enlarged space by the equivalence relation of the group of motions of the n Killing vector fields. (auth)

25078 GAUGE FIELDS ARISING FROM SPACETIME SYMMETRIES AND GRAVITATIONAL THEORIES. I. Agnese, A.G.; Calvini, P. (Istituto di Scienze Fisiche dell'Università, Genova, Italy). Phys. Rev. D 12: No. 12, 3800-3803 (15 Dec 1975).

The Utiyama method of obtaining an interaction from an invariance principle is applied in the case of external (spacetime) symmetries. The "gauge" fields arising from a spacetime symmetry with respect to a general N-parameter Lie group are introduced following Kibble's extension. The corresponding formulas are obtained, which are more general than Kibble's and are reduced to Kibble's if we identify the generic N-parameter group with the Poincaré 10-parameter group. (auth)

25079 GAUGE FIELDS ARISING FROM SPACETIME SYMMETRIES AND GRAVITATIONAL THEORIES. II. Agnese, A.G.; Calvini, P. (Istituto di Scienze Fisiche dell'Università, Genova, Italy). Phys. Rev. D 12: No. 12, 3804-3809 (15 Dec 1975).

The consequences of covariance of the matter Lagrangian under gauge transformations of the second kind of the 15-parameter conformal group are investigated. In order to accomplish this, 44 fields (16 vierbein fields $h_k{}^\mu$, 24 rotational gauge fields $A^{ij}{}_\mu$, and 4 scale gauge fields ϕ_μ) are introduced. Furthermore, a Brans-Dicke-type scalar field is used to construct a simple "vacuum" Lagrangian, which is easily reducible to the Einstein Lagrangian; the derived dynamical theory is investigated in the most general case and in various particular cases. Connections are established to many works on this subject. Finally a link is established between the mass of the scalar field and the cosmological constant of Einstein's theory. A possible value is calculated. (auth)

25080 INTEGRAL FORMALISM OF GAUGE FIELDS AND GENERAL RELATIVITY. Carmeli, M. (Department of Physics, Ben Gurion University of the Negev, Beer Sheva 84120, Israel). Phys. Rev. Lett. 36: No. 1, 59-61 (5 Jan 1976).

Yang's new integral theory for gauge fields associated with the group $GL(n)$ is discussed for the particular case when $GL(n)$ is reduced to $SL(2, C)$. It is pointed out that, in this particular case, the theory gives the vacuum Einstein equations, but not the full equations. A modification giving nonvacuum equations consistent with the Einstein theory is pointed out. The field variables are then written as operators. (auth)

25081 THE RETARDED SOLUTION OF THE SCALAR WAVE EQUATION BY MEANS OF GREEN'S FUNCTIONS. Bird, J.M. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England); Dixon, W.G. Ann. Phys. (N.Y.) 94: No. 2, 320-348 (Oct 1975).

A formula is obtained for the retarded solution of the scalar wave equation in a curved space-time, with boundary conditions appropriate to the case of asymptotic flatness. By means of a conformal transformation, the retarded solution is evaluated in the slow-motion expansion. It is shown that it is necessary to impose further asymptotic restrictions on the source for the usual iterative method to give the correct retarded solution to the given degree of approximation. The weak field case is briefly considered, with the same result. (auth)

REACTOR TECHNOLOGY AND REGULATION

25082 (GEEST-75-001(Vol.1)) SMALL NUCLEAR PROCESS HEAT PLANTS (SNPH) USING PEBBLE BED REACTOR. Volume I. (General Electric Co., Fairfield, Conn. (USA). Energy Systems and Technology Div.). Nov 1975. 459p. (ORNL-SUB-4352-1(Vol.1)). Dep. NTIS $12.00.

For Union Carbide Corp., Oak Ridge, TN.

Conceptual designs are presented of a VHTR 500 MW(t) helium cooled, pebble bed reactor (PBR) coupled separately to a steam generator, steam reformer or closed cycle gas turbine for the production of process steam, hydrogen, and/or electricity. An intermediate heat exchanger (IHX) between the reactor coolant and the process stream was a study requirement. Engineering feasibility, costs and the necessary development programs are presented. (auth)

25083 (GEEST-75-001(Vol.2)) SMALL NUCLEAR PROCESS HEAT PLANTS (SNPH) USING PEBBLE BED REACTOR. Volume II. (General Electric Co., Fairfield, Conn. (USA). Energy Systems and Technology Div.). Nov 1975. 307p. (ORNL-SUB-4352-1(Vol.2)). Dep. NTIS $9.75.

For Union Carbide Corp., Oak Ridge, TN.

Chapters are included on safety, the development program, resource requirements, district heat in West Germany, the FRG concept, materials, and alternate studies. (JWR)

25084 (JPRS-66768) TRANSLATIONS ON EASTERN EUROPE. 11 Feb 1976. Translation of Scientific Affairs No. 499. 50p. NTIS.

Translations of articles from Meres Es Automatika are presented. A separate abstract is included for one article. (JWR)

For an abstract of an individual paper see: 25127.

25085 (LA-UR-75-2352) HIGH TEMPERATURE NUCLEAR PROCESS HEAT SYSTEMS FOR CHEMICAL PROCESSES. Jiacoletti, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1976. Contract W-7405-eng-36. 21p. (CONF-760402-3). Dep. NTIS $3.50.

From 81st national meeting of the American Institute of Chemical Engineers; Kansas City, Missouri, United States of America (USA) (11 Apr 1976).

The development planning and status of the very high temperature gas cooled reactor as a source of industrial process heat is presented. The dwindling domestic reserves of petroleum and natural gas dictate major increases in the utilization of coal and nuclear sources to meet the national energy demand. The nuclear process heat system offers a unique combination of the two that is environmentally and economically attractive and technically sound. Conceptual studies of several energy-intensive processes coupled to a nuclear heat source are presented. (auth)

25086 (NP-20813) QUALITY ASSURANCE PROGRAM, DUKE-1. Amendment 1. Lee, W. S. (Duke Power Co., Charlotte, N. C. (USA)). 1 Oct 1974. 58p. Duke Power Co., Charlotte, NC.

The Duke Power Company quality assurance program for all phases of its nuclear power plants is presented. The organization and program for quality assurance during the design, initial procurement, construction and operation of nuclear power plants is presented. Included in this section are organization charts, a listing of quality assurance and technical functions, and point-by-point comparisons of the Engineering Quality Assurance Program and Construction Quality Assurance Program with the 18 criteria of 10CFR50, Appendix B. (auth)

25087 (PNCT-831-75-01) TOKAI WORKS SEMIANNUAL PROGRESS REPORT, JULY–DECEMBER 1974. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Jun 1975. 117p. Dep. NTIS (US Sales Only) $5.50.

Activities of Tokai Works during the latter half of 1974 are summarized in the areas of plutonium fuels development, fuel reprocessing, and development of centrifugal uranium enrichment. (auth)

25088 (REG/G-1.104(2-76)) OVERHEAD CRANE HANDLING SYSTEMS FOR NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Office of Standards Development). Feb 1976. 10p. NUREG.

Methods acceptable to the NRC for complying with regulations with regard to the design, fabrication, and testing of overhead crane systems for reactor refueling and spent fuel handling operations are described. (JWR)

25089 (REG/G-1.114(2-76)) GUIDANCE ON BEING OPERATOR AT THE CONTROLS OF A NUCLEAR POWER PLANT. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Feb 1976. 2p. NUREG.

25090 (SAND-75-6257) QA PROGRAMS IN NUCLEAR POWER PLANTS. Ellingson, A. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1976. 30p. (CONF-760108-1). Dep. NTIS $4.00.

From conference on quality costs and the customer; Albuquerque, New Mexico, United States of America (USA) (17 Jan 1976).

As an overview of quality assurance programs in nuclear power plants, the energy picture as it appears today is reviewed. Nuclear power plants and their operations are described and an attempt is made to place in proper perspective the alleged "threats" inherent in nuclear power. Finally, the quality assurance programs being used in the nuclear industry are described.

25091 INDUSTRIAL APPLICATIONS OF NUCLEAR ENERGY FOR NONGENERATING USES. Moranville, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs); Patarin, L.; Rastoin, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Rev. Energ.; 26: No. 274, 686-698(Jun 1975). (In French)

A technico-economical study of industrialization problems involved in the direct use of nuclear heat or its conversion into a form of energy other than electricity is presented. (FR)

25092 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE. Volume 37. Conference Held at Chicago, Illinois, April 21–23, 1975. Chicago; American Power Conference (1975). 1269p. (CONF-750469-). $25.00.

From annual american power conference; Chicago, Illinois, USA (21 Apr 1975).

Papers are presented on the broad aspects of the electric power industry and related fields of activity. Thirty-two of the papers are abstracted individually for Nuclear Science Abstracts (NSA), 22 for ERDA Energy Research Abstracts (ERA), 22 for Energy Abstracts for Policy Analysis (EAPA), and 73 for the ERDA Energy Data Base only. One paper appeared previously in NSA as CONF-750469-1. (LMT)

For abstracts of individual papers see: 23882, 23883, 25093, 25109–25112, 25130–25135, 25145, 25146, 25187–25189, 25268–25270, 25285, 25293–25296, 25302, 25312, 25313, 25324, and 25325.

25093 ELECTRIC UTILITY INDUSTRY'S NUCLEAR PLANT RELIABILITY DATA SYSTEM. Haueter, R. L. (Consumers Power Co., Jackson, MI). Proc. Am. Power Conf.; 37: 170-172 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

A status report is provided on implementation of the system and some general observations are made on where the industry is going in the matter of reliability of plant components and the availability of electric generating units. (auth)

25094 CONSIDERATIONS ON HIGH TEMPERATURE REACTORS FOR PROCESS HEAT APPLICATIONS. Kugeler, K.; Kugeler, M.; Niessen, H. F.; Hohn, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Nucl. Eng. Des.; 34: No. 1, 15-32(Oct 1975).

The technical problems in process heat reactor applications caused by high temperatures, i.e., fuel element design, contamination by solid fission products as well as the increased corrosion of the core and the fuel elements, are explained. A survey of components to be modified, different possible forms of hot-gas ducting, the vessel concept as well as details about the reflector design are given. An elaborate description is given of the problems of the intermediate circuit, i.e., various flow schemes, arrangements and designs as well as a consideration of the advantages and disadvantages. A detailed representation of the most important reactor parameters as well as design-limiting conditions is given to demonstrate the manifold application possibilities of HTR systems for process heat generation. This review concludes with a description of the safety aspect of nuclear process heat plants, especially afterheat removal, shutdown of the reactor as well as various novel accidents such as the rupture of reformer tubes. (NL)

25095 DESIGN OF A 3000 MW(th) HIGH TEMPERATURE REACTOR FOR PROCESS HEAT APPLICATIONS. Kugeler, K.;

Kugeler, M.; Niessen, H. F.; Hohn, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Nucl. Eng. Des.; 34: No. 1, 33-49(Oct 1975).

The nuclear part of a possible process heat plant for the steam reforming of methane to produce hydrogen is described in principle. It is shown that there is a fair degree of freedom in nuclear reactor design, because of the many free parameters that exist, such as the vessel concept, the type of hot-gas ducting, reactor parameters and the fuel cycle. Initially, a flow scheme and the mass and energy balances are given. Thereafter, as one of the possible designs, a representation of the pod-boiler system is given, and particularly the heat exchangers as well as the core design are explained. Special components of the pebble bed reactor as well as the charging installations are also elaborately described. The loop design can be considered as an alternative concept to the prestressed concrete vessel in the pod-boiler concept. The conditions and special questions of this design are discussed. (NL)

25096 MOTIVATION FOR AND POSSIBILITIES OF USING NUCLEAR PROCESS HEAT. Dietrich, G.; Eickhoff, H. F.; Niehaus, F.; Niessen, H. F. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Systemforschung und Technologische Entwicklung). Nucl. Eng. Des.; 34: No. 1, 3-13(Oct 1975).

High temperature reactors (HTRs) with spherical fuel elements are not only characterized by high conversion rates reducing uranium requirements to a minimum, but they also supply heat at a high temperature level. Besides electricity supply, this will also open up the much larger heat market to nuclear energy. Nuclear process heat can be used by way of energy transported over long distances or by district heating. It may also be used to cover the heat requirements in refining plants. This is shown by means of a supply strategy for the Federal Republic of Germany using secondary energy carriers. Profitability studies have shown that nuclear process heat has a number of economic advantages over conventional heat generation, which are also supplemented by ecological benefits (e.g., reduction in waste heat, SO_2 and CO_2 emissions). The ecological aspect will, no doubt, be of particular significance in the future, since even today some of the man-induced rates are reaching the levels of natural rates of mobilization of materials. (NL)

25097 GROWING NEED FOR NUCLEAR ENERGY IN SWITZERLAND. Krafft, P. (Electro-Watt Engineering Services Ltd., Zurich). Nucl. Eng. Int.; 20: No. 231, 556-558(Jun 1975).

The structure of the Swiss Electrical Industry and the activities of the government in relation to energy are described. Production and consumption of electric power and the introduction of nuclear power into the system are discussed. Some guidelines are suggested for future development of the industry. (UK)

25098 ROLE OF SWISS CONSULTING ENGINEERS. Heller, A. (Electro-Watt Engineering Services Ltd., Zurich); Zund, H. Nucl. Eng. Int.; 20: No. 231, 574(Jun 1975).

Traditional Swiss engineering capability, the early start in nuclear technology, and wide experience, have provided Swiss consulting engineers with special advantages that can be of benefit to both developed and underdeveloped countries. The services the Swiss consulting engineering companies have provided when participating in nuclear power projects both on the home market and abroad are briefly outlined. (UK)

25099 NUCLEAR INDUSTRY CHART. No. 19: Switzerland. Nucl. Eng. Int.; 20: No. 231, 569(Jun 1975).

As part of a survey on Switzerland a pull-out organization chart is presented of the nuclear industry showing Swiss government bodies and industrial concerns. Their interests, connections with each other, and their associations with international and other national organizations and firms are indicated. (UK)

25100 NUCLEAR POWER STATION CONSTRUCTION IN SWITZERLAND. Leder, R. A. (Schweizerische Vereinigung fuer Atomenergie, Bern). Elektrizitaetsverwertung; 50: No. 1, 18(Jan 1975). (In German)

The following topics are briefly discussed: the recently published report on the environmental impact of the cooling tower for the Ruthi project; the information center for the Leibstadt power station; the 1973 annual report of the Swiss Federal Commission for Radioactivity Supervision. (INIS)

25101 TOWN HEATING AND ENERGY SUPPLY BY MEANS OF TOTAL ENERGY POWER STATIONS. Deuster, G. Schweiz. Bauztg.; 92: No. 44, 997-1002(31 Oct 1974). (In German)

The importance, technical aspects and advantages of district space and water heating schemes are briefly considered and statistical figures given for the progress achieved in the German Federal Republic. The different types of total energy power station are discussed and their technical, operational, environmental and national/economic characteristics are compared. Reference is made to the 50-MW helium gas turbine and the refuse fired boiler installation at Oberhausen. The role of nuclear energy is discussed and process heat and coal gasification are briefly discussed with an appraisal of likely future trends. (INIS)

25102 REVIEW OF EIR PROGRAM ACTIVITIES. Buob, K. H.; Seifritz, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 422-426 (Nov 1974). (In German)

The technical projects in hand in the EIR (Federal Research Institute) are discussed, and a breakdown is given in terms of projects with the associated personnel (manyears) and financial (1000 Sw. Fr.) allocations. Projects under development are HHT (high temperature reactor with helium turbine), fuel element development, reactor physics, chemistry and safety, the GCFR Zero-power-facility "Proteus," the SGFR bubble detector, corrosion of structural materials, molten salt reactor, radiation technology and training facilities. The totals involved for 1974 were 211.2 man years and 17,041,000 Swiss Francs. (INIS)

25103 DEVELOPMENT FUNCTIONS OF THE EIR. Demarmels, P.; Seifritz, W.; Spiess, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuernenlingen (Switzerland)). Neue Tech.; 16: No. 11, 444-449(Nov 1974). (In German)

Various courses of studies in progress in the EIR on reactor subjects are described. These include those for reactor operators, engineers, and shift managers, and a refresher course. Reactor technology is studied with the aid of "Saphir" and "Diorit" research reactors. Sample syllabi are outlined in terms of duration, previous knowledge assumed, course composition and terminal tests. Approximate numbers of students are given. (INIS)

25104 STATUS OF THE E.I.R. IN SWISS NUCLEAR REACTOR TECHNOLOGY. Graenicher, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 419-422(Nov 1974). (In German)

An historical survey of the work of the Institute since the "Atoms for Peace" conference in 1955 is presented. Particular features are the development of research reactors "Saphir" and "Diorit." After some reorganization, development work has continued on the Lucens reactor and on submarine reactor cores, and at the Würenlingen Institute. Economic aspects of total energy use are considered. In the previous 13 years Swiss total energy consumption growth has averaged 6.6% per year and electricity 4.7% per year. Future developments envisaged are work on high temperature reactors, with either Th-232 or U-238 as fertile material, cooling tower developments, solar energy and fusion technology. (INIS)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 25250, 25251, 25256–25261, 25266, 25268, 25270, and 25316–25320.

25105 (REG/G-1,84(Rev.5)(2-76)) CODE CASE ACCEPTABILITY: ASME SECTION III DESIGN AND FABRICATION. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Feb 1976. 6p. NUREG.

Code Cases of the Section III ASME Boiler and Pressure Vessel Code that are acceptable for the design and fabrication of LWR power plant components are listed. (JWR)

25106 (REG/G-1,85(Rev.5)(2-76)) CODE CASE ACCEPTABILITY: ASME SECTION III MATERIALS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Feb 1976. 6p. NUREG.

Code Cases of Section III ASME Boiler and Pressure Vessel Code oriented toward materials and testing that are acceptable in the licensing of LWR power plants are listed. (JWR)

25107 (RT/FI-(75)14) CNEN CALCULATION METHOD FOR THE NEUTRONIC DESIGN OF LWR CORES: REACTIVITY AND POWER DISTRIBUTIONS IN x,y GEOMETRY VERSUS BURN-UP. Part I. The Physical Model of the BURNY-BEVE Code System. Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Aug 1975. 120p. Dep. NTIS (US Sales Only) $5.50.

The physical model of the BURNY-BEVE code (k_{eff} and power distribution vs. burn-up for LWR core in x,y geometry) is described; in particular: (1) all the necessary information on the original physical model is collected; and (2) all the extensions (concerning the treatment of Gd as a burnable poison and Rod Cluster Control for PWRs) and updating work performed after 1970 are presented. The BURNY-BEVE code was validated in

past years for a wide set of experimental data including not only critical experiments, but also operating power reactors. (auth)

25108 INTERGRANULAR STRESS-ASSISTED CORROSION CRACKING OF AUSTENITIC ALLOYS IN WATER-COOLED NUCLEAR REACTORS. Cheng, C. F. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 57: No. 1, 11-33(Jul 1975).

Corrosion-cracking incidents of structural components and fuel-element cladding in 30 water-cooled reactors have been reported. All pressure boundary penetrations have small seeping leaks, but pipe severance has not occurred. Failures of the non-pressurized boundary components have been limited to small fasteners and screws, none of which have constituted potential nuclear safety hazards, directly or indirectly, nor damage involving other components. The cracking incidents involving Types 304, 304L, and 347 stainless steel, Incoloy 800, and Inconel 600 were attributed to intergranular stress-assisted corrosion cracking associated with (1) oxygen, (2) caustic, or (3) hydrogen. Sensitization increases the susceptibility to cracking in dissolved oxygen, but it is not a factor in caustic solution. Other material conditions, corrective actions, and mechanisms of intergranular stress-assisted corrosion cracking are discussed. (NL)

25109 SOME GENERAL CONSIDERATIONS ON NUCLEAR PLANT STARTUP, OPERATION, AND ECONOMICS. Ma, B. M. (Iowa State Univ., Ames). Proc. Am. Power Conf.; 37: 122-128 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The well planned startup of a large nuclear reactor is of paramount importance for the public safety. The safe and economic operation of a large nuclear plant (or central power station) is of primary interest for the utility industry and the general public who use electricity. Nuclear power has achieved economically commercial status as a safe, reliable, flexible and competitive energy source for electrical generation. Among a number of proposed types of nuclear reactors, the light-water reactor (LWR), including pressurized-water reactor (PWR) and boiling-water reactor (BWR), has taken a predominant position with wide commercial acceptance. In the considerations of nuclear plant startup and operation, the startup program planning and time schedule from nuclear fuel loading to warranty run should be established and reviewed in detail by the prime contractor, component suppliers and owner(s). The operating conditions of reactor pressure vessel, piping and pumping systems, fuel assemblies, fuel management, vibration control, coolant quality, etc., should be examined, observed, and corrected stringently. In the nuclear plant economic consideration, the trends of unit plant cost, and total nuclear power cost (excluding the inflation factor) decrease with increasing cumulative plant capacity, while the trends of fuel burnup and thermal efficiency increase with cumulative plant capacity. In the current to near-term reactor development and technology, the LWR nuclear plants have a high potential for technological and economic improvement. (auth)

25110 GENERAL ELECTRIC FUEL PERFORMANCE UPDATE. Judge, F. D.; Williamson, H. E.; Weiss, D. T. (General Electric Co., San Jose, CA). Proc. Am. Power Conf.; 37: 257-266(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

A summary is presented of some of the facets of fuel and fuel channel performance of current interest. (auth)

25111 PROTECTING DRESDEN 1 REACTOR COOLANT MATERIALS FROM CORROSION DURING DECONTAMINATION AND AFTER RETURN TO SERVICE. Staehle, R. W. (Ohio State Univ., Columbus). Proc. Am. Power Conf.; 37: 271-281(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Commonwealth Edison has instituted a plan to decontaminate Dresden Unit 1 in order to reduce radiation exposures. The procedure chosen involves a chemical decontamination wherein the decontaminating solution will be circulated, followed by a rinsing. A new solvent was formulated for this procedure since previously available ones were ineffective. The full-scale cleaning of Dresden Unit 1 is scheduled for 1977. A discussion is presented of the corrosion aspects of the decontaminating process, and important issues which were considered in developing the decontaminating solution are described. Various tasks involved in assessing possible corrosion problems are described and available results are summarized. (auth)

25112 DEVELOPING A SOLVENT, PROCESS, EQUIPMENT, AND PROCEDURES FOR DECONTAMINATING THE DRESDEN-1 REACTOR. Harmer, D. E. (Dow Chemical Co., Midland, MI); Frauson, F. P. Jr.; Snyder, M. A.; Anders, O. U.; Holloway, J. J. Proc. Am. Power Conf.; 37: 282-288(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Investigation of the many alternative methods for reduction of radiation levels in the Dresden-1 Nuclear Power Station showed chemical cleaning to be the best choice. However, none of the existing published solvent systems provided both the required decontamination factor and freedom from secondary problems. Accordingly, a new formulation, Dow Solvent NS-1, was developed. It was demonstrated both as to efficiency—decontamination factors to 1000 with the very retentive radioactive deposits—and as to safety through a corrosion test program. The procedures for application of this solvent have been completed. Safety evaluation indicates no new or unusual problems during the operation. (auth)

25113 OPERATING EXPERIENCE WITH PWR AND BWR STATIONS IN SWITZERLAND. Beznau Nuclear Power Station and Muehleberg Nuclear Power Station. Kueffer, K. P. (Nordostschweizerische Kraftwerke A. G., Beznau, Switzerland); Lutz, H. R. Nucl. Eng. Int.; 20: No. 231, 561-566(Jun 1975).

Valuable operating experience has been obtained with the two 350 MW(e) PWR units at Beznau and the 350 MW(e) BWR at Muhleburg. Both stations have suffered faults including troubles with fuel, steam generators and balance of plant items, which have necessitated periods of shut down and reduced output. Modifications and repairs have been successful and satisfactory load factors are being achieved. (auth)

25114 SWISS NUCLEAR POWER PLANTS UNDER CONSTRUCTION AND PROJECTED. Vogt, H. W. (Kernkraftwerk Goesgen-Daeniken A. G.; Daeniken, Switzerland); Schumacher, H.; Graf, P.; Weyermann, P.; Pommann, F. Nucl. Eng. Int.; 20: No. 231, 566-572(Jun 1975).

Switzerland is firmly committed to five new nuclear power projects, two of which are under construction. In addition there are proposals for nuclear power stations at Ruthi (900-100 MW(e)) in the northeast of Switzerland and at Verbois (1000 MW(e)) on the western outskirts of Geneva. Of particular interest are the cooperative arrangements for financing, building and operating power stations. Most of the projects are having to contend with lengthy licensing procedures. In spite of the existence of large rivers there is a move to use cooling towers to satisfy environmental demands. The present status of the five new stations Gosgen, Leibstadt, Kaiseraugst, Graben, and Inwil is described and main parameters are given for the first three. (UK)

25115 BWR NOISE SPECTRA AND APPLICATION OF NOISE ANALYSIS TO FBR. Nomura, T. (Nippon Atomic Industry Group Co., Ltd., Kawasaki, Japan). Ann. Nucl. Energy; 2: No. 2-5, 379-389(Jun 1975).

From European-American committee on reactor physics specialist meeting on reactor noise: from critical assemblies to power reactors; Rome, Italy (21 Oct 1974).

Work related to noise analysis studies by Tokyo Shibaura Electric Co Ltd (Toshiba) and Nippon Atomic Industry Group Co Ltd (NAIG) for the pase several years is reviewed. After considering the Japan-United States Seminar on Reactor Noise Analysis in 1968, other subjects discussed are boiling water reactor noise analysis and work in relation to FBR. Parts of these are related to each other. For example, boiling detection and temperature fluctuations are problems pertinent to both fields. As the main problems in zero-power-reactor noise are now basically understood, only a brief description of the experiments involving the advanced two-detector method is given. Focus is rather placed on the area of power plant noise. (auth)

25116 STOCHASTIC STUDY OF NOISE IN BOILING REACTORS. Matthey, M. (Swiss Federal Inst. of Tech., Lausanne). Ann. Nucl. Energy; 2: No. 2-5, 271-276(Jun 1975).

From European-American committee on reactor physics specialist meeting on reactor noise: from critical assemblies to power reactors; Rome, Italy (21 Oct 1974).

A stochastic point model is considered of a boiling reactor, involving the population of neutrons, the population of delayed neutron precursors, fuel temperature, and the number of bubbles in the coolant as random variables. Whereas the first two variables are related to capture, fission and delayed neutron processes, the other two take into account heat transfer between fuel and coolant and changes in coolant density. The variations in the fuel temperature and the coolant density generate reactivity feedbacks which affect the neutron power spectral density; analysis of the shape of this spectral density is expected to give information on the value of reactor parameters such as, for example, the void coefficient. (UK)

25117 RECIPROCITY RELATIONSHIPS FOR THE ISOTOPIC COMPOSITION OF BOILING WATER REACTOR FUEL. Gallar,

O. H. (Purdue Univ., Lafayette, IN); Hindley, P. Nucl. Mater. Manage.; 4: No. 3, 582-587(Fal 1975).

From 16th annual meeting of the Institute of Nuclear Materials Management, Inc.; New Orleans, LA, USA (18 Jun 1975).

The results of calculations for the isotopic composition of irradiated and shuffled BWR fuel are presented. (JWR)

25118 ANALOGIC LINEAR NETWORK OF THE DYNAMIC BEHAVIOR OF A BWR. Incerti, S. M.; De Antoni, G. (Rome Univ. (Italy)). Calore; 44: No. 7, 328-344(1973). (In Italian)

An analog linear network of the dynamic behavior of a BWR nuclear reactor was realized. It was obtained with the functional diagram of the system on the analog computer PACE 231/R, and based upon references of Caorso-BWR nuclear power plant. The response to a sinusoidal reactivity perturbation is also shown. (INIS)

25119 THE BASIS FOR FUEL BURNUP: A MODERN BLOCK CODE. Paratte, J. M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 461-465(Nov 1974). (In French)

Basic equations for neutron flux equations for water reactors are formulated. A model of a BWR fuel cell is illustrated, and also a cylindrical sub-group of a full cell. The condensation of bidimensional geometry with over 20 neutron energy groups is described. An outline computer program is shown based on the BOXER code which has eight subgroups, INPUT (basic data), ADAPT (thermal diffusion effects), MICROFAST (epithermal domaines), MICROTHERM (thermal domaines), BOXOL (flux geometry), CODIFF (bidimensional diffusion), DOIT3 (alternative to CODIFF) and TIMESTEP (isotopic densities). (INIS)

25120 MEASUREMENT OF EFFECTIVE $^{235}U\alpha$ FOR THE VK-50 REACTOR. Gabeskiriya, V. Ya.; Novikov, Yu. B.; Sadulin, V. P. Sov. At. Energy (Engl. Transl.); 38: No. 2, 144(Feb 1975).

Translated from At. Energ. (USSR), 38: No. 2, 110(Feb 1975).

The ratio of the uranium 235 radiative capture to fission cross sections is reported for various integral hard neutron spectra. The measurements were made by the mass spectrometric method using samples cut from a standard VK-50 fuel element. (DG)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 25105–25109, 25113, 25114, 25231–25233, 25237, 25256–25261, 25267, 25268, and 25321.

25121 (BAW-10067(Rev.2)) CONTAINMENT ISOLATION VALVES. Wrobel, G. J.; Leinhart, D. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 14p. Babcock and Wilcox, Lynchburg, VA.

Revised data on containment isolation valves for Babcock and Wilcox PWR's are presented. (JWR)

25122 (BAW-10097A(Rev. 2)) MARK C (17 x 17) FUEL ASSEMBLY. Research and Development. Revision 2. Stoudt, R. H.; Klink, P. H.; Walton, L. A. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 59p. Babcock and Wilcox, Lynchburg, VA.

The research and development programs related to the B and W Mark C (17 x 17) fuel assembly are described. The programs described are designed to provide data for analytical models, confirm predictions, and verify the adequacy of the design. A general description of the Mark C assembly is presented along with comparisons to the Mark B (15 x 15) fuel assembly (the Mark C fuel assembly is an extension of B and W's existing Mark B fuel assembly technology and the planned testing programs draw on the experience gained in the Mark B development program). The report is organized in three main test areas: (1) mechanical and hydraulic, (2) critical heat flux, and (3) rod swelling and burst. The test program scopes and objectives are discussed along with the test methods. (auth)

25123 (BAW-10114) PROLIB: CODE TO CREATE PRODUCTION LIBRARY OF NUCLEAR DATA FOR DESIGN CALCULATIONS. Wittkopf, W. A.; Tilford, J. M.; Furtney, M. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 93p. Babcock and Wilcox, Lynchburg, VA.

This PROLIB program creates, updates, and edits the production library used in the B and W nuclear design system. The production library contains the material cross section data required to perform the thermal and epithermal spectrum calculations in the NULIF program. PROLIB collapses cross section data from the master libraries, produced by the ETOGM and THOR programs, to the desired production library group structures. The physics models that are used, the calculations that are performed in PROLIB, the input, and the output are described. Information that is required to use PROLIB along with a sample problem that illustrates the input and output formats and that provides a benchmark problem are given. (auth)

25124 (BAW-10124) FLAME 3: A THREE-DIMENSIONAL NODAL CODE FOR CALCULATING CORE REACTIVITY AND POWER DISTRIBUTIONS. Mays, C. W.; Furtney, M. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1976. 57p. Babcock and Wilcox, Lynchburg, VA.

The FLAME 3 nodal code calculates core reactivity and three-dimensional power distributions with thermal-hydraulic feedback effects. It employs variable dimensioning, which permits the user to size his own problem subject to the total core storage of the computer. Lagrange interpolation is used for fitting variable data. This allows any input-dependent variable to be fit versus as many as three independent core variables. A transient xenon capability is included, which enhances the code's usefulness in performing maneuvering analyses. Control rod data are input by node, permitting the treatment of partial-length control rods. The various models, including the programmed equation, are described. (auth)

25125 (CENPD-162(Suppl.1)) CRITICAL HEAT FLUX: CORRELATION FOR C–E FUEL ASSEMBLIES WITH STANDARD SPACER GRIDS. Part 1. Uniform Axial Power Distribution. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jan 1976. 24p. Combustion Engineering, Inc., Windsor, CT.

Responses to NRC questions concerning critical heat flux correlation and supporting data for CE fuel assemblies with standard spacer grids in the case of a uniform power distribution are presented. (JWR)

25126 (JEN-307) FUEL MANAGEMENT STUDY AND NUCLEAR CYCLE DESIGN FOR PW REACTORS. Minguez, E.; Ahnert, C.; Aragones, J. M. (Junta de Energia Nuclear, Madrid (Spain)). 1975. 149p. (CONF-750753-1). Dep. NTIS (US Sales Only) $6.00.

From 18th NEA-CRP meeting; Bologna, Italy (9 Jul 1975).

A reference reactor was chosen to do a general study involving Fuel Management Evaluations of several cycles, and Design Calculations of cycles already performed, according to a calculation scheme set up in the Reactor Technology Division of the J.E.N. using some computer codes acquired from foreign sources and other ones developed in the J.E.N. (auth)

25127 (JPRS-66768, pp 24-33) SOME COMPUTER-TECHNOLOGICAL ASPECTS OF THE SIMULATION OF A NUCLEAR POWER PLANT WITH PRESSURIZED WATER REACTOR. Szilagyi, B. (Budapest Technil University); Benedek, S.; Homoki, G. 11 Feb 1976. Translated from Meres Autom., 34: No. 10, 375-378(1975).

In translations on eastern Europe.

The construction of analog and digital computer simulation models suitable for the dynamic study of the primary cycles of pressurized-water type nuclear power plants is described. The model permits the study of normal operations, malfunction conditions, and stability matters. Solution of the mathematical model that characterizes the technological processes of the nuclear power plant is made difficult mainly by computer-technological factors. The analog model may also be used as a simulator in the training of operating personnel. (auth)

25128 (RD/B/N-3239) RESULTS OF BURN-UP MEASUREMENTS ON TWO ASSEMBLIES FROM BEZNAU 1 (PWR). Dawson, J. T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1975. 30p. Dep. NTIS (US Sales Only) $4.00.

Thirty-six pins from assemblies 58 and 80, discharged at the end of the first operating cycle of the PWR Beznau Unit 1, were gamma scanned using a high resolution Ge(Li) detection system to measure axial and pin-to-pin burn-up distributions. Relative burn-ups determined independently from the measured concentrations of the fission products ^{137}Cs and ^{144}Ce mutually agreed to ±1% (1σ). Good agreement was also obtained with mass spectrometry measurements carried out at Harwell on a few sample pellets. The measurements demonstrated that the Westinghouse predictions of relative pin-to-pin burn-up (i.e., those available to the reactor operator) were accurate to within ±1.4% (1σ) throughout both assemblies, with no significant effect from one assembly to the other. Absolute pin burn-ups were deduced from a combination of the gamma scanning and Harwell mass spectrometry results. The corresponding Westinghouse estimates (with the pin-to-pin fine structure errors removed) agreed with experiment to within the combined measurement uncertainties of less than ±3% (1σ). Local burn-up peaks of up to (9 ± 1)% were observed in fuel adjacent to collapsed cladding in a neighboring pin. It was shown that previous measurements of this peaking made on a simple

NaI detection system should be reduced by a scaling factor of 0.83. (auth)

25129 (WCAP-8647) ANALYSIS OF FUEL ROD FRETTING WEAR. Schmugar, K. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 1975. 25p. Westinghouse Electric Corp., Pittsburgh, PA.

A semiempirical method for calculating the fretting wear on a fuel rod due to flow-induced vibration is presented. The method utilizes fuel rod amplitude data from a hydraulic flow test along with the Archard theory. The method for determining the fuel rod amplitude, the use of the Archard wear equation and the parameters for the equation are described. A comparison of the calculated and experimentally measured wear is presented to show the validity of the method. (auth)

25130 POSTOPERATIONAL TEST AND EXAMINATION: OCONEE UNIT 1. Parker, W. O. Jr. (Duke Power Co., Charlotte, NC); Deddens, J. C.; Berger, D. W.; Hladek, K. L. Proc. Am. Power Conf.; 37: 96-105(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Results of several inspection and examination programs undertaken during the first refueling outage are presented. Data are presented on the once-through-steam generator performance, fuel performance, radiation monitoring, and reactor component inspection. (DG)

25131 APPLICATION OF IN-BUNDLE MEASUREMENTS TO THE DESIGN OF STEAM GENERATORS FOR THE WESTINGHOUSE 3800-MWt PWR PLANT. Bennett, R. R. (Westinghouse Electric Co., Tampa, FL). Proc. Am. Power Conf.; 37: 106-112 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The Model E Steam Generator has been designed with sophisticated thermal hydraulic flow distribution codes to maximize the local velocities along the tube-sheet and minimize the accumulation of solids. In-bundle instrumentation has provided the means to verify these computer codes on full-size operating steam generators. These measurements have provided conclusive evidence that the local thermal hydraulics can be controlled by both geometric and operating parameters as predicted by the computer codes. In addition, these data have provided excellent supplementary verification of the laboratory verified computer codes. As a result of in-bundle instrumentation program, the computer codes were able to be utilized to their fullest extent to optimize flow distribution in the Model E with a high degree of assurance. (auth)

25132 SPHERICAL CONTAINMENT SYSTEM FOR 1300-MWe PWRs. Godfrey, D. A. (Duke Power Co., Charlotte, NC); Schabert, H. P.; Loeb, W. A. Proc. Am. Power Conf.; 37: 113-121(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Duke Power Company is designing six nuclear power plants for two three-unit sites. These plants will incorporate dual spherical containments housing Combustion Engineering's 1300-MWe System 80 nuclear steam supply system. The spherical containment design for these plants is the result of a detailed evaluation of past and present containment concepts. The containment system used by Duke Power Company incorporates many features of the spherical containment system used by Kraftwerk Union for its units that are already in operation, under construction, or in design. (auth)

25133 OPERATIONAL EXPERIENCE WITH PWR SECONDARY WATER CHEMISTRY: A PANEL PRESENTATION, SAN ONOFRE UNIT 1. Britt, R. D.; Millard, R. E.; DiFilippo, M. N. (Southern California Edison Co., Rosemead, CA). Proc. Am. Power Conf.; 37: 753-760(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The three steam generators have been on phosphate chemistry since startup except for one brief period when volatile chemistry was attempted. Initially, coordinated pH-phosphate control was recommended by Westinghouse for the steam generators; however, after one year of operation, Westinghouse recommended changing to congruent control. From startup in 1967 until the end of 1970, the Na/PO_4 molar ratio was generally maintained in the 2.6 to 2.8 range, with a 5 to 10 ppM phosphate residual. A summary of steam generator chemistry from initial startup to the present is presented. (auth)

25134 STEAM GENERATOR OPERATING EXPERIENCE AT THE YANKEE PLANT. Randazza, J. (Maine Yankee Atomic Power Plant, Augusta, ME). Proc. Am. Power Conf.; 37: 760-764(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The successful experience of Yankee Rowe with AVT (all volatile treatment) for condensate control in secondary coolant circuits is described. (DG)

25135 EPRI-ASME PROGRAM TO STUDY PWR SECONDARY WATER CHEMISTRY. Martel, L. J. (Electric Power Research Inst., Palo Alto, CA); Pearl, W. L. Proc. Am. Power Conf.; 37: 765-771(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The Electric Power Research Institute, working with the Utility Subcommittee of the ASME, EEI Chemistry Subcommittee of the Prime Movers Committee, Corrosion Advisory Committee, and various utility companies, has made a major start to define a developing problem area of PWR steam generators and to initiate programs required for its solution. A systems approach is being taken to alleviate the problem for the short term and solve the problem in the long term. (auth)

25136 REACTOR INSTALLATION. Dorner, H.; Michel, E. (to Siemens Aktiengesellschaft). US Patent 3,901,196. 26 Aug 1975. Priority date 30 May 1973, German, Federal Republic of (F.R. Germany). 6p.

A reactor installation has a pressurized-water reactor pressure vessel with its bottom fixed against downward movement and an upper portion which connects via a horizontal straight coolant-loop pipe, with the lower portion of a vertical steam generator horizontally offset from the pressure vessel and positioned at a higher level than the latter. The bottom of the steam generator is supported by a cam follower which rides on a fixedly positioned cam surface which inclines upwardly away from the pressure vessel. With varying temperatures the pressure vessel expands and contracts vertically so that its upper portion moves up and down, but the pressure vessel also radially expands and contracts and the coolant pipe does likewise in its longitudinal or axial direction, the resulting horizontal motions being transmitted via the end of the coolant pipe connected with the steam generator to the latter, the cam angularity being such that the steam generator is displaced horizontally and vertically in such a manner that the coolant pipe remains substantially horizontal and free from compressive stress other than that required to move the steam generator via the cam follower fixed to its bottom, through up and down motion on the inclined cam surface. (Official Gazette)

25137 NUCLEAR REACTOR EQUIPPED WITH A FLOODING TANK AND A RESIDUAL HEAT REMOVAL AND EMERGENCY COOLING SYSTEM. Schabert, H. P.; Winkler, F. (to Siemens Aktiengesellschaft). US Patent 3,929,567. 30 Dec 1975. Priority date 11 Apr 1972, German, Federal Republic of (F.R. Germany). 10p.

A description is given of a nuclear reactor such as a pressurized-water reactor or the like which is equipped with a flooding tank and a residual heat removal and emergency cooling system. The flooding tank is arranged within the containment shell at an elevation above the upper edge of the reactor core and contains a liquid for flooding the reactor core in the event of a loss of coolant.

25138 IRRADIATION EXPERIMENTS ON REACTOR PRESSURE VESSEL MATERIAL OF THE BEZNAU NUCLEAR PLANT. Ullrich, G. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland). Abt. Metallurgie); Sandona, E. (Nordostschweizerische Kraftwerke A. G., Doettingen. Kernkraftwerk Beznau). Neue Tech.; 16: No. 11, 456-460(Nov 1974). (In German)

The safety aspects of the pressure vessels fabricated in thick plate, arising from irradiation embrittlement, are discussed mainly with reference to NDTT concepts (nil-ductility-transition-temperature), the Charpy V-notch tests and wedge opening loads. Some typical results are shown for ductility data for the Beznau reactor vessel over the range −100 to +100°C. Examination techniques are also mentioned in relation to other concepts including lateral expansion, notch root contraction and crack opening displacement to ASME-code tests and to DIN 51,222 and DIN 50,115. (INIS)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 25094, 25095, 25235, and 25240.

25139 (AED-CONF-75-233-001) COOLING TOWERS AND THE MICROCLIMATE. Graenicher, H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). 1975. 12p. (In German). INIS.

From project high-temperature reactor with helium turbine–Status report; Juelich, F. R. Germany (2 Jun 1975).

6 figs.

Three different types of dry cooling towers and several types of cooling elements are studied and optimized on the basis of proposed design data. The most important possible effects on the microclimate are listed. A newly developed one-dimensional stationary computer model will help to calculate plumes of dry and wet cooling towers and their effects on the surrounding air down to the ground. Finally, current measurements are reported. (DE)

25140 (CONF-760303-1) HTGR FUEL AND FUEL CYCLE TECHNOLOGY. Lotts, A. L.; Coobs, J. H. (Oak Ridge National Lab., Tenn. (USA)). 1976. 5p. Dep. NTIS $3.50.

From ASME-ANS joint international conference on advanced nuclear energy systems; Pittsburgh, Pennsylvania, United States of America (USA) (13 Mar 1976).

The high-temperature gas-cooled reactor is a flexible system. The all-ceramic core permits high outlet temperatures compared to other reactors; thus, it is possible for the HTGR to be used with both steam cycle and gas turbine generating equipment. Also, the HTGR can be used as a source of high-temperature process heat. Core outlet temperatures of 700°C are now available for the steam cycle. For very advanced HTGRs, temperatures as high as 1000°C may be expected. HTGR fuel designs have a number of variations of geometry, fuel composition, and nonnuclear structural materials. Fuel cycle possibilities include the low-enrichment cycle and the Th-^{233}U cycle; with plutonium utilization in either cycle. All of this flexibility complicates the fuel design and fuel cycle technology for the reactor. This paper examines the complexities involved, emphasizes the status of fuel development and fuel cycle technology, and projects what may be possible in future applications. (auth)

25141 (EIR-291) SYMBIOTIC NUCLEAR ENERGY PARK AS THE ULTIMATE PRIMARY ENERGY SOURCE FOR SWITZERLAND: GENESIS AND RATIONALE. Huwyler, S.; Seifritz, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jan 1976. 48p. (CONF-760304-3). Dep. NTIS (US Sales Only) $4.00.

From 1st world hydrogen energy conference; Miami Beach, Florida, United States of America (USA) (1 Mar 1976).

An optimum nuclear reactor strategy towards a long-range energy independence for Switzerland is described. The potential reactor family, consisting exclusively of Fast Breeder Reactors (FBR) and various High Temperature Gas Cooled Reactors (HTGR's), are supposedly assembled as an underground nuclear energy park in a mountain of the Alps, called an "Energy Mountain", in analogy to an "Energy Island". The main feature of the symbiotic reactor system is the coupled fuel cycle which will then permit practically a uranium-ore-and separative-work-independent energy economy. It is shown that the amount of natural uranium and thorium which is necessary to feed the system in equilibrium can be effectively extracted from granite of the Swiss Alps where an abundant amount of these rocks is available having a content of 80–100 ppm uranium and throrium with the required ratio of U to Th. The whole system is considered to be the ultimate primary energy source of an all entropy energy economy based upon clean and wasteless secondary energy carriers like electricity, hydrogen for industry, reducing gases (H_2 + CO) for metal reducing complexes and methanol production, heat for long distance process heat applications, electricity generation and district heating, and hot water for district heating in the vicinity of the park. It is shown that even a country like Switzerland, without any fossil resources at all, may have optimistic long-range perspectives with respect to the question of energy dependence. The domestic low grade uranium and thorium reserves in its granite enable a nuclear scenario which guarantees in the asymptotic state an abundant and virtually inexhaustible primary energy source. (auth)

25142 (GA-A-13277) SUMMARY OF F-30 CAPSULE ANALYSIS AND CAPTEM CODE MODIFICATIONS. Smith, G. L. (General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1975. Contract E(04-3)-633. 74p. Dep. NTIS $5.45.

The thermal analysis performed on the F-30 test capsule is reported, and the assumptions, problem areas, modifications to the CAPTEM code, and results are summarized.

25143 (GA-A-13422) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1975. Contract AT(04-3)-633. 19p. Dep. NTIS $4.00.

The continuation of the research and development program for the Public Service Company of Colorado 330-MW(e) High-Temperature Gas-cooled Reactor is described. The work reported includes nuclear analysis of the fuel cycle, fuel zoning, and power shaping. Experimental procedures and results are discussed. (auth)

25144 (ORNL/TM-4931) THERMAL TRANSPORT PROPERTIES OF HELIUM, HELIUM–AIR MIXTURES, WATER, AND TUBING STEEL USED IN THE CACHE PROGRAM TO COMPUTE HTGR AUXILIARY HEAT EXCHANGER PERFORMANCE. Tallackson, J. R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 110p.

A description is presented of the thermal transport properties of the materials involved in digital computer calculations of heat transfer rates by the core auxiliary heat exchangers in large HTGR nuclear steam supply systems. These materials are pure helium, mixtures of helium with common gases having molecular weights in the range of 28 to 32, alloy steel tubing, and water. For use in programmed computations the viscosity, thermal conductivity, and specific heat are represented primarily by equations augmented by curves and tabulations. Materials supporting the development and selection of the property equations are included. (auth)

25145 GAS TURBINE HTGR PLANT: ECONOMICAL DRY COOLING OR A WET-COOLED HIGH-EFFICIENCY BINARY CONFIGURATION. Schoene, T. W.; Winkler, E. O.; Fortescue, P. (General Atomic Co., San Diego, CA). Proc. Am. Power Conf.; 37: 363-378(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The dry-cooled gas turbine HTGR plant offers the means whereby power plant siting flexibility can be substantially increased without efficiency penalty or cost disadvantage. With other advantages of the basic HTGR, the result is a nearly environmentally neutral plant. Optionally, the binary-cycle gas turbine HTGR maximizes electrical output from available cooling water and nuclear fuel resources because of the very high efficiency achievable by combining the closed-cycle gas turbine with a vapor secondary-power cycle. For either option, the resulting power plant offers the highest available nuclear efficiencies with lower generating costs and with minimum environmental impact. (auth)

25146 PREOPERATIONAL CHEMICAL CLEANING OF FORT ST. VRAIN NUCLEAR GENERATING STATION SYSTEMS. Tatum, C. B. (Ebasco Service Inc., New York); Schuetzenduebel, W. G.; Riebe, J. J.; Eisenhofer, J. J. Proc. Am. Power Conf.; 37: 772-780(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The Fort St. Vrain Chemical Cleaning Operation presented significant challenges because of various plant design features, the advanced status of preoperational testing, and the high level of results required. Intensive preplanning, careful administrative controls, and the cooperation of each of the several organizations involved combined to meet this challenge in less than scheduled time, in compliance with all cleaning specification criteria, and without damage to plant operating systems. (auth)

25147 A NUCLEAR REACTOR WITH MODERATOR BLOCK COLUMNS. (to British Nuclear Design and Construction Ltd., Whetstone). French Patent 2,234,635/A/. 22 May 1974. 15p. (In French)

Nuclear reactors provided with a core formed by hexagonal fuel moderator blocks are so designed as to facilitate their loading with fuel. The pressurized core enclosure comprises inlet-wells the axis of each of which coincides with the common edge of three adjacent columns of a group comprising these three columns and the nine columns in the immediate vicinity of the latter the loading machine being provided with radially movable means adapted to act on the blocks of any given column of the group. The invention can be applied in particular to high-temperature reactors. (FR)

25148 GAS-COOLED NUCLEAR REACTOR. (to British Nuclear Design and Construction Ltd., Whetstone). French Patent 2,232,822/A/. 4 Jun 1974. 9p. (In French)

The invention aims at simplifying gas-cooled nuclear reactors. For the cooling gas, the reactor is provided with a main circulation system comprising one or several energy conversion main groups such as gas turbines, and an auxiliary circulation system comprising at least one steam-generating boiler heated by the gas after its passage through the reactor core and adapted to feed a steam turbine with motive steam. The invention can be applied to reactors the main groups of which are direct-cycle gas turbines. (FR)

25149 INITIAL RESULTS OF INVESTIGATIONS INTO FISSION PRODUCT DEPOSITION IN IN-PILE EXPERIMENTS. Iniotakis, N.; Malinowski, J.; Muenchow, K. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reactorbauelemente). Nucl. Eng. Des.; 34: No. 1, 169-180(Oct 1975).

The safe operation of a high temperature reactor (HTR) depends to a decisive extent on the behavior of the fission products released from the fuel elements into the primary loop and on the nuclides resulting from activation. The mechanisms of transport and deposition for fission and activation products were investigated. It is the aim of the experimental and theoretical efforts to develop a realistic model for deposition which permits calculating the deposition onto components of the primary loop and allows an assessment of the possibility for service and repair of the individual components. Beyond this, the model should serve as the basis for the realistic consideration of the consequences of a failure in the reactor. The initial results of the Saphir–Pegase and Vampyr–AVR in-pile experiments are discussed. (NL)

25150 PRELIMINARY OPERATING EXPERIENCES WITH THE AVR AT AN AVERAGE HOT-GAS TEMPERATURE OF 950°C. Knuefer, H. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Juelich (F.R. Germany)). Nucl. Eng. Des.; 34: No. 1, 73-83(Oct 1975).

The two-loop system with a high temperature reactor, which is operated by the Arbeitsgemeinschaft Versuchsreaktor (AVR) GmbH and which was built by the BBC/Krupp consortium (today HRB), has been in operation for more than seven years. In that time more than 635×10^6 kWhr have been produced and more than 6.5×10^5 spherical fuel elements have been circulated under operation. The fully integrated design, and above all the ceramic gas duct, permit very high gas temperatures although no high alloyed, heat resistant steels were used in the reactor. In February 1974 the average hot-gas temperature at the outlet of the core could thus be increased from its original design value of 850°C. Peak temperatures of above 50°C are thereby confined to a small region between the middle of the core and the beginning of the steam generator. Carbon protects the steel structures against high temperatures. Unplanned interruptions and reductions of operation due to the increase of the hot-gas temperature have not occurred so far. Some thermocouples in the hot-gas region failed. All other components functioned satisfactorily and, one year after the increase in the hot-gas temperature, there are no misgivings as to their future functioning. These satisfactory but short operating experiences at 950°C will have to be supplemented in the next few years by experiences over a longer period. (NL)

25151 INVESTIGATION OF THE IMPURITIES AND FISSION PRODUCTS IN THE AVR COOLANT GAS AT AN AVERAGE HOT-GAS TEMPERATURE OF 950°C. Engelhard, J.; Krueger, K. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Juelich (F.R. Germany)); Gottaut, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorbauelemente). Nucl. Eng. Des.; 34: No. 1, 85-92(Oct 1975).

Since 27 February, 1974, the AVR pebble bed reactor has been producing gas at an average temperature of 950°C. The preparations for a temperature increase and the first experimental results obtained with a hot-gas temperature of 950°C are reported. Measured data are given on the behavior of inactive gaseous impurities, on the increase of fission gas activities, and on the increase of concentrations of solid fission products in the helium coolant gas. While the activities of the fission gases showed an insignificant increase in the coolant gas, considerable increase of activity was measured for solid fission products, especially for Ag isotopes. However, activities released from fuel elements are low so that there are no operational or safety problems. (NL)

25152 FUEL ELEMENTS OF THE HIGH TEMPERATURE PEBBLE BED REACTOR. Wolf, L.; Ballensiefen, G.; Froehling, W. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Nucl. Eng. Des.; 34: No. 1, 93-108(Oct 1975).

This work is devoted to spherical fuel elements for the high temperature pebble bed reactor, their manufacture and the conditions which they must satisfy for use in a process-heat reactor with an average gas outlet temperature of 950°C. The positive results known from the operation of the AVR at 950°C and from extensive irradiation tests of the THTR-300 element with BISO coated mixed-oxide particles, even beyond the range of design specifications, and possible damage mechanisms are described in detail. They show that a spherical fuel element already exists, for which only a short-term development is needed to produce a coolant temperature of 950°C in a process-heat reactor. Further developments will be characterized by the use of a pebble bed HTR for high conversion rates ($c \sim 0.95$) or for average gas outlet temperatures of more than 950°C. At higher temperatures the increased demands, mainly with regard to the release of fission products, can be fulfilled through the application of TRISO-coated fuel particles and the doping of the fuel kernels with Al_2O_3/SiO_2. The reprocessing programme for fuel elements in the Federal Republic of Germany is mentioned briefly. (NL)

25153 CORE PHYSICS AND FUEL CYCLES OF THE PEBBLE BED REACTOR. Teuchert, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung); Ruetten, H. J. (Technische Hochschule Aachen (F. R. Germany). Lehrstuhl fuer Reaktortechnik). Nucl. Eng. Des.; 34: No. 1, 109-118(Oct 1975).

A high degree of flexibility for the application of the pebble bed HTR results from the size of the fuel elements and the continuous loading of fuel during operation. The OTTO loading scheme (once-through-then-out) allows the gas outlet temperature to be increased up to 1190°C as desired. Different fuel cycles can be used in the same reactor. The highly enriched uranium/thorium fuel cycle allows favorable utilization of the fissile reserves. For a conventional design the net consumption is 476 g/GWd(t), and this figure can be reduced to 58 g/GWd(t) for the advanced variant, achieving the breeding ratio 0.95. The advantage of the low enrichment uranium fuel cycle is the direct in situ utilization of the bred plutonium, being as high as 87%, which reduces the demand for short-term recycling. The reactor allows changeover between the different cycles under full power operation. (NL)

25154 PHYSICS OF HIGH-TEMPERATURE REACTORS. Massimo, L. Oxford; Pergamon Press (1976). 243p.

The subject is covered in chapters entitled: general description of the HTR core; general considerations about reactor physics; neutron cross sections; basic aspects of transport and diffusion theory; methods for the solution of the diffusion equation; slowing-down and thermalization in graphite; resonance absorption; spectrum calculations and cross-section averaging; burn-up; core design; fuel management and cost calculations; temperature coefficient; core dynamics and accident analysis; reactor control; peculiarities of HTR physics; analysis of calculational accuracy; sequence of reactor design calculations. (UK)

25155 THE NUCLEAR POWER STATION PROJECT UTILIZING A HIGH-TEMPERATURE REACTOR WITH A DIRECT-CYCLE GAS TURBINE (HHT). Sarlos, G.; Markoczy, G.; Zollinger, E.; Dupont, J. F.; Schenker, E.; Haschke, D. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 449-456(Nov 1974). (In French)

The HHT study is a joint German-Swiss venture. The gas flow cycle is illustrated, and shows the main items: reactor, turbine, compressor, recuperator and cooler, the latter being coupled to a conventional cooling tower. Supporting paragraphs are included on power station design, heat exchangers, reactor dynamics, decontamination, neutron and γ flux and atmospheric pollution control. The basic design is for a plant of about 1000 MW(e) with helium entry and exit temperatures at the reactor of about 500 and 850°C at a pressure of about 60 bars. The pressure in the L. P. circuit is about 24 bars. (INIS)

25156 DRAGON HIGH TEMPERATURE REACTOR PROJECT SIXTEENTH ANNUAL REPORT, 1974–1975. Paris; Organization for Economic Co-Operation and Development (1975). 99p. (NP–20797). O.E.C.D. Publication Center, Washington, DC.

Activities are described in the areas of reactor operation, reactor fuels and materials technology, and administration. (DG)

25157 DRAGON HIGH TEMPERATURE REACTOR PROJECT FIFTEENTH ANNUAL REPORT, 1973–1974. Paris; Organization for Economic Co-Operation and Development (1974). 69p. (NP–20812). O.E.C.D. Publication Center, Washington, DC.

Activities at the OECD High Temperature Reactor Project are reported. Sections are included on the irradiation program, Dragon Reactor support, fuel manufacture and post-irradiation operations, fuel and graphite, primary circuit materials, and power reactor physics and advanced applications.

Power Reactors, Non-Breeding, Otherwise Moderated

25158 (AECL-4444) PROPERTIES OF DOUGLAS POINT GENERATING STATION HEAT TRANSPORT CORROSION PRODUCTS. Montford, B.; Rummery, T. E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 44p. Dep. NTIS (US Sales Only) $4.00.

Chemical, radiochemical and structural properties of circulating and fixed corrosion products from the Douglas Point Generating Station are documented. Interaction of Monel-400 and carbon steel

corrosion products is described, and the mechanisms of Monel-400 surface deposit release, and activity buildup in the coolant system, are briefly discussed. Efficiencies of filters and ion-exchangers for the removal of released radionuclides are given. (auth)

25159 (AECL-5117) NUCLEAR POWER FOR DISTRICT HEATING. Lyon, R. B.; Sochaski, R. O. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1975. 70p. Dep. NTIS (US Sales Only) $4.50, AECL $1.50.

Current district heating trends are towards an increasing use of electricity. The evaluation of an alternative means of energy supply, the direct use of thermal energy from CANDU nuclear stations, is described. The energy would be transmitted via a hot fluid in a pipeline over distances of up to 40 km. Advantages of this approach include a high utilization of primary energy, with a consequent reduction in installed capacity, and load flattening due to inherent energy storage capacity and transport delays. Disadvantages include the low load factors for district heating, the high cost of the distribution systems and the necessity for large-scale operation for economic viability. This requirement for large-scale operation from the beginning could cause difficulty in the implementation of the first system. Various approaches have been analyzed and costed for a specific application—the supply of energy to a district heating load centre in Toronto from the location of the Pickering reactor station about 40 km away. (auth)

25160 (NP-20789) CANDU 600. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Sep 1975. 23p. Dep. NTIS (US Sales Only) $3.50.

Included are discussions of the standardized reaction design, plant design, heat transport system, moderator system, station instrumentation and control, safety systems, and electrical service power system. (DG)

25161 FLEXIBILITY IN FUELLING. Gray, J. L. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Nucl. Act.; No. 12, 20-25(Jan 1975).

Some of the ways in which the Canadian heavy water moderated nuclear power reactors will flourish in spite of changing fuel economics are discussed. (INIS)

25162 REMOVING HEAVY WATER FROM A GASEOUS COOLANT. Ermolaev, M. I.; Petlitsa, A. P.; Kapitanov, V. F.; Batishchev, V. V. Sov. At. Energy (Engl. Transl.); 38: No. 2, 142-143 (Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 109-110(Feb 1975).

The results are presented of an investigation into the removal of D_2O from CO_2 by means of zeolites in an enlarged laboratory apparatus. In addition to studying the general laws governing the process of D_2O adsorption by zeolite, another purpose of the work was to obtain data for the design of industrial installations, particularly installations for drying carbon dioxide under pressure. (auth)

Power Reactors, Breeding

Refer also to abstracts 22699, 23425, 25115, 25141, 25230, 25236, 25238, 25241–25248, 25252, 25254, 25275, and 25310.

25163 (AERE-R-8096) GRAIN BOUNDARY LOSS TERMS IN STUDIES OF FISSION GAS RELEASE. Hayns, M. R.; Wood, M. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1975. 19p. Dep. NTIS (US Sales Only) $3.50.

Within the framework of a previously suggested model for the nucleation and growth of gas bubbles within nuclear fuel, from rare gas atoms produced during nuclear fission, the time dependent release of gas from within the fuel grains is examined. Three approaches have been considered; a rate theory model incorporating a grain boundary loss term which is time independent, the explicit solution of the spatially dependent diffusion equations, and a rate theory model incorporating a time dependent grain boundary loss term. It is shown that gas release predictions obtained using the approximate rate theory approach may differ considerably from that obtained by solving the spatially dependent diffusion equation, and that the use of a simple gas atom diffusion model for gas release, which does not consider the internal sinks, may lead to completely erroneous results. (auth)

25164 (ANL-CT-75-42) VIBRATION OF FUEL BUNDLES. Chen, S. S. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 69p. Dep. NTIS $4.50.

Several mathematical models have been proposed for calculating fuel rod responses in axial flows based on a single rod consideration. The spacing between fuel rods in liquid metal fast breeder reactors is small; hence fuel rods will interact with one another due to fluid coupling. The objective of this paper is to study the coupled vibration of fuel bundles. To account for the fluid coupling, a computer code, AMASS, is developed to calculate added mass coefficients for a group of circular cylinders based on the potential flow theory. The equations of motion for rod bundles are then derived including hydrodynamic forces, drag forces, fluid pressure, gravity effect, axial tension, and damping. Based on the equations, a method of analysis is presented to study the free and forced vibrations of rod bundles. Finally, the method is applied to a typical LMFBR fuel bundle consisting of seven rods.

25165 (ANL-RPD-45) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, NOVEMBER 1975. (Argonne National Lab., Ill. (USA)). Nov 1975. Contract W-31-109-Eng-38. vp. AT.

This progress report summarizes the Argonne National Laboratory work performed for the Reactor Development Program during November 1975 in the following research and development areas: Experimental Breeder Reactor No. II (EBR-II), LMFBR design support, instrumentation and control, fuels and materials development, reactor physics, reactor safety, and GCFR design.

25166 (ANL-RDP-46) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, DECEMBER 1975. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. vp. AT.

Progress is summarized in the following research and development areas: Experimental Breeder Reactor No. II (EBR-II), LMFBR Design Support, Instrumentation and Control, Fuels and Materials Development, Reactor Physics, Reactor Safety, and Other Fast Breeder Reactors. (auth)

25167 (ANL-Trans-1033) OXYGEN DETERMINATION IN LIQUID SODIUM WITH A CONTINUOUS ELECTROCHEMICAL MEASURING PROBE. Jung, J. Translated from J. Nucl. Mater.; 56: 213-220(1975). 13p. Dep. NTIS $3.50.

In order to measure continuously the oxygen content of sodium, a measuring probe was developed: it operates with the aid of ThO_2–Y_2O_3 solid electrolyte and a reference gas electrode. The probe consists of a solid electrolyte crucible, connected by a vacuum-tight soldered joint to a metal tube. Experiments with oxygen-saturated sodium, using reference gases with varying partial pressures of oxygen, showed that almost reversible emf's are attainable; the free standard enthalpy of formation thus determined, DELTA G°/sub Na_2O/, agrees well with published values. The calibration of a probe in a sodium loop revealed a linear relationship between the measured emf and the inverse cold-trap temperature, but deviations from reversible cell behavior were observed. 16 references. (auth)

25168 (ANL-Trans-1035) CHOICE OF CHARACTERISTICS OF A LARGE FAST REACTOR POWER PLANT. Chaumont, J. M.; Ravier, J. Translated from Bull. Inf. Sci. Tech. (Paris); No. 182, 7-12(1973). 11p. Dep. NTIS $3.50.

A brief description is given of an optimization method which allows the designer to select the characteristics of a liquid metal fast breeder reactor with the least energy cost criterion. (FR)

25169 (ANL-Trans-1037) REACTOR BLOCK AND FUEL HANDLING. Abramson, R.; Aubert, M.; Berniolles, J. M.; Merland, D.; Sauvage, M.; Verriers, P.; Leduc, J. Translated from Bull. Inf. Sci. Tech. (Paris); No. 182, 29-38(Jun 1973). 11p. Dep. NTIS $3.50.

Preliminary studies of the reactor block and fuel handling of a high power reactor lead to the comparison of different designs leading to a choice using technological knowledge acquired with Rapsodie and Phenix. Since then, studies have been done concerning the following decisions: the number of pumps and heat exchangers, number and function of vessels, upper closures, and transfer and discharge systems. Several designs for integrated primary circuits have also been developed. After these studies, an adequate number of elements were touched upon in order to recommend a system with: four pumps and eight heat exchangers, a major vessel lined with a security vessel, upper closures comprised of low heat insulation which is completed by a transfer system with three rotating plugs, and the discharge crossing the base. The results of studies of the design of the primary circuit allow mainly for the choice of a solution of a low step relay or a siphon pump. The choice cannot be made, since additional studies are necessary. (auth)

25170 (ANL-Trans-1038) SODIUM TECHNOLOGY SOME UNSOLVED PROBLEMS. Elie, X.; Jacquelin, R.; Chouard, P.; Duquesne, J. C. Translated from Bull. Inf. Sci. Tech. (Paris); No. 182, 53-60(1973). 15p. Dep. NTIS $3.50.

Some studies and tests must be completed or undertaken to obtain a better knowledge of the material technology of sodium in order to allow greater freedom in designing reactor components. Tests concerning mechanisms must be multiplied either at an elementary stage or at the stage of components; fundamental tests in the field of friction, cavitation, or frozen sodium seals have to be developed. (FR)

25171 (ANL-Trans-1039) CONTROL AND MONITORING OF A FAST REACTOR. Lions, N.; Baron, J.; Berger, R. Translated from Bull. Inf. Sci. Tech. (Paris); No. 182, 71-84(Jun 1973). 26p. Dep. NTIS $4.00.

The use of liquid sodium as a coolant gave rise to a number of measurement and control problems, most of which are new. Specific instrumentation is required to take into account the special properties of this fluid. New problems arose such as: water leakage detection in sodium, visualization in an opaque fluid, cladding failure detection and especially location in the sodium coolant; and moreover the difficulties connected with a highly compact core. Other research work extending beyond the sodium cooled reactors was undertaken in the field of ultrasonic techniques and acoustical detection. Ultimately a more general approach led to studying a core defect detection and diagnostic system using overall processing of data measured in the reactor, to detect failures at the very moment they occur. (auth)

25172 (BNWL-tr-166) TEMPERATURE DISTRIBUTION IN A BOR-60 REACTOR CORE. Kazachkovski, O. D.; Antipin, G. K.; Griazev, V. M. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Melekess (USSR)). 1972. Translation by D. Fuller of NIIAR-P-133. 29p. Dep. NTIS $4.00.

Fuel assembly temperature distributions were studied at the outlet of core bundles and vertically in separate cross-sections of an operational bundle for a series of power values and coolant flow rates through the reactor. The temperature at the core bundle outlets was measured by thermocouples in a post-bundle control system. A thermometric package was used for measuring the temperatures in operational bundle cross sections. Temperature values at the fuel bundle outlets were determined by the results of flow meter measurements. Power release distributions were determined radially and vertically in the core. From the research conducted non-uniformity coefficients in temperature distribution in the reactor core were obtained and safe power levels of the assembly with a given loading were determined. (auth)

25173 (EURFNR-1257) EXPERIMENTAL STUDY OF THE TEMPERATURE DISTRIBUTION BELOW SPACERS IN SMOOTH AND ROUGH ROD CLUSTERS. Marek, J.; Rehme, K. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Mar 1975. Translation of KFK-2128. 51p. Dep. NTIS $4.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

An experimental investigation was performed of the heat transfer in smooth and rough rod bundles near spacer grids. Detailed wall temperature distributions were measured which clearly demonstrated that even in rod bundles roughened by artificial roughness there are no hot spots near spacer grids. On the basis of the few experimental results from the literature and the new data, heat transfer correlations are proposed for smooth and rough surfaces near spacer grids. These correlations allow a prediction to be made in a good approximation of the heat transfer near spacer grids as a function of the flow contraction due to the spacer. (auth)

25174 (GEAP-10028-56) CORE ENGINEERING. Fifty-Sixth Quarterly Report, August–October 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1975. Contract E(04-3)-893. 33p. AT.

The objective of the work reported is to provide the engineering design basis for the core of a liquid metal cooled fast breeder reactor. Progress is described for tasks related to Grid Spaced Driver Assembly, Wire-Wrap Assembly Engineering, Core Component, Structural Design Criteria, and Probabilistic Design. (auth)

25175 (GEAP-14031-5) CORE RESTRAINT ENGINEERING. Fifth Quarterly Report, August–October 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1975. Contract E(04-3)-893. 14p. AT.

LMFBR core restraint system design requirements, subcomponents, and analytical methods are discussed. Progress is described for subtasks related to national core restraint development activities, withdrawal force testing, transient analysis, assembly interaction effects, load monitoring, and instrumented simulated fuel assembly efforts.

25176 (GEAP-14074-1) COOPERATIVE NUCLEAR DATA AND METHODS DEVELOPMENT. First Quarterly Report, July–September 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1975. Contract E(04-3)-893. 17p. AT.

The report presented is the first in a series of quarterly reports published under the Cooperative Nuclear Data and Methods Development Program. The objective of the work reported under this program is to support cooperative evaluations of nuclear data and analytical design tools to expedite implementation of these in reactor design applications and to perform specific analytical physics tasks required to support the Fast Breeder Reactor Program including an evaluation of the nuclear feasibility of significantly impacting the waste disposal problem by utilizing actinide recycle.

25177 (HEDL-TME-75-12) COMPILATION OF DATA AND DESCRIPTIONS FOR UNITED STATES AND FOREIGN LIQUID METAL FAST BREEDER REACTORS. Appleby, E. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-2170. vp. Dep. NTIS $13.60.

This document is a compilation of design and engineering information pertaining to liquid metal cooled fast breeder reactors which have operated, are operating, or are currently under construction, in the United States and abroad. All data has been taken from publicly available documents, journals, and books. (auth)

25178 (HEDL-TME-75-44) EVALUATION OF THE EFFECTS OF AN INTEGRAL FIN SPACER DESIGN ON PREDICTED FUEL PIN AND SUBASSEMBLY DUCT PERFORMANCE. Sutherland, W. H.; Cantley, D. A.; McCurry, D. C.; Parker, M. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan. 1976. Contract E(45-1)-2170. 36p. Dep. NTIS $5.00.

The effect of an integrally finned fuel pin cladding design on LMFBR subassembly performance has been evaluated. Effects on thermal/hydraulics, fuel pin lifetime and duct lifetime are considered. Results are presented for 19, 61 and 217 pin subassemblies.

25179 (HEDL-TME-75-64) SODIUM TECHNOLOGY TECHNICAL PROGRESS REPORT, APRIL, MAY, JUNE 1975. Atwood, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-2170. 133p. Dep. NTIS $7.60.

Progress is reported in the following areas: radioactivity control technology, FFTF sodium characterization system, corrosion and process control, and fuel failure monitoring systems for FFTF and CRBRP. (JWR)

25180 (HEDL-W/F-732091) RECOMMENDATIONS OF THERMAL PERFORMANCE MODELS FOR LIFE-II. Jackson, R. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1976. 4p. Dep. NTIS $3.50.

Improved equations for fuel conductivity, fuel thermal expansion, and fuel-cladding gap conductance are recommended for inclusion in the LIFE-II code.

25181 (LA-6077-MS) POSTIRRADIATION RESULTS AND EVALUATION OF SODIUM-BONDED URANIUM–PLUTONIUM CARBIDE FUEL ELEMENTS IRRADIATED IN EBR-II. Interim Report. Latimer, T. W.; Bost, D. S.; Kerrisk, J. F.; Barner, J. O.; Green, J. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-Eng-36. 23p. AT.

An evaluation was made of the performance of all sodium-bonded uranium-plutonium carbide fuel elements irradiated in EBR-II. Of these 52 fuel elements, 27 have completed irradiation and 38 are unfailed. The failure ratio was significantly greater for fuel elements which were clad in 0.25 mm Type 316 stainless steel compared with those in 0.30 to 0.45 mm stainless steel or Incoloy 800 cladding. In some fuel sections, asymmetric patterns of swelling and beta-gamma activity were observed which corresponded to the shape of isotherms in the fuel if gas bubbles were present in the bond. Irregular ovalities in the cladding, believed to be caused by wedging of fuel fragments into positions that exert localized stresses on the cladding, were markedly reduced in the only element examined that was clad in 20 percent cold-worked Type 316 stainless steel. Interim radiographic examination at 3 at. percent burnup showed that 0.09-mm-thick perforated tubes around the fuel pellets were effective in containing fuel fragments. The major compatibility effect observed was the transfer of carbon to the cladding. A significant decrease in the depth of carburization was observed for elements containing single-phase (U,Pu)C compared with those containing 5-20 percent $(U,Pu)_2C_3$. No penetration of cladding alloys by fission products was detected. (auth)

25182 (ORNL/TM-4838) LAND-USE CHANGES ON THE PROPOSED CLINCH RIVER BREEDER REACTOR DEMONSTRATION. Project Site: 1924 to 1972. McConathy, R. K. (Oak Ridge National

Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 27p. Dep. NTIS $5.00.

A report is presented which documents the use history of the CRBRDP site and is also the first in a series to describe ecological areas on the ERDA Oak Ridge Reservation meeting criteria for scientific study sites or natural areas worthy of preservation. The CRBRDP area under discussion is located in Roane County, Tennessee and is a part of the land purchased in 1942 by the United States Government for the Manhattan Project, now known as the ERDA Oak Ridge Reservation. (auth)

25183 (ORNL-TM-4998) EXPERIMENTAL STUDIES OF RADIATION HEATING IN IRON AND STAINLESS STEEL SHIELDS FOR THE CRBR PROJECT. 189 No. OH004, Activity No. KG 10 04 01 1. Clifford, C. E.; Muckenthaler, F. J.; Maerker, R. E.; Stevens, P. N.; Abele, R. K.; Simons, G. G.; Yule, T. J.; Driscoll, M. J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 45p. AT.

A series of radiation heating measurements in heavy-metal shield configurations performed at the Oak Ridge National Laboratory are described. Simultaneous measurements were made by personnel from the Argonne National Laboratory, from the Massachusetts Institute of Technology and from the Oak Ridge National Laboratory. The experimental techniques being evaluated involved the use of calcium fluoride (CaF_2) and lithium fluoride (^7LiF) thermoluminescent dosimeters (TLDs) and a high-pressure argon-krypton-filled ion chamber designed and built by the Oak Ridge National Laboratory Instrumentation and Controls Division. Intercomparison of the experimental results and comparison with calculation provides a meaningful evaluation of the experimental techniques for measuring the energy depositions. It was shown that the ^7LiF-TLD measurements and the ion chamber results were about 14 percent higher than the CaF_2-TLD measurements. The calculations were found to be about 2 to 5 percent lower than the CaF_2-TLD measurements for the iron configuration and about 15 to 20 percent lower than the CaF_2-TLD measurements for the stainless steel configuration. Even greater disparities were found between calculation and measurement for the ^7LiF-TLD and ion chamber dosimeters.

25184 (ORNL/TM-5244) STATUS AND POTENTIAL OF EUROPIUM-BASED FAST NEUTRON ABSORBER MATERIALS. Pasto, A. E.; Morgan, C. S. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 38p. AT.

A summary of the selection and developmental status of four potential fast neutron absorber materials being evaluated for use in LMFBRs is presented. Results of synthesis, characterization, densification, and physical properties measurements are reported for EuB_6, EuN, europia-refractory metal cermets, and europium carbides. Carbides are judged to be unacceptable because they are difficult to synthesize, volatile, and react with atmospheric water and oxygen. Apparently the only truly stable carbide, EuC_2, has an unacceptably low nuclear worth. Europium nitride, on the other hand, is readily synthesized but is also volatile and reactive toward components in the ambient atmosphere. Hence, EuN was dropped from further consideration, even though its nuclear worth is excellent. Europium hexaboride and Eu_2O_3-refractory metal cermets are found to be promising candidate absorber materials because of their attractive physical properties and good nuclear worth. (auth)

25185 DRIVING FORCES FOR BUBBLE GROWTH AND SWELLING IN MX-TYPE FAST BREEDER FUELS. Blank, H. (Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). J. Nucl. Mater.; 58: No. 2, 123-139(Nov 1975).

After giving a definition of three types of swelling, geometrical, local and microscopic swelling, the in-pile working conditions for MX-type fast breeder fuels are briefly described. The equilibrium and non-equilibrium conditions for fission gas bubbles are summarized and a model for bubble interaction is deduced. On the basis of experimental data a curve T_{kb} is established. T_k defines the critical swelling temperature as function of burn-up b at which the transition occurs from microscopic swelling with a low rate of swelling S_M to local swelling S_A with a high rate. The curve T_{kb} can be defined as the saturation limit of the fuel matrix with regard to small fission gas bubbles beyond which bubble interaction causes the small bubbles to change into large ones. The implications of the existence of that curve for fuels working under Na-bonding and under He-bonding conditions are briefly discussed. (NL)

25186 SWELLING ANALYSIS OF HIGHLY RATED MX-TYPE LMFBR FUELS. I. Restructuring and Porosity Behaviour. Ronchi, C.; Sari, C. (Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). J. Nucl. Mater.; 58: No. 2, 140-152(Nov 1975).

Four MX-type fuels (U,Pu)C, $(U,Pu)C_{0.5}N_{0.5}$, $(U,Pu)C_{0.2}N_{0.8}$, and (U,Pu)N have been irradiated in helium-bonded pins at heat ratings up to 1300 W/cm. The swelling behavior has been analyzed on the basis of the complex restructuring occurring during the irradiation. The swelling mechanisms in the different restructured zones have been investigated with the aid of laboratory annealing experiments. Finally the properties of the different fuels have been discussed. Carbides provide acceptable swelling behavior only under restricted temperature and temperature gradient conditions, whereas nitrides exhibit homogeneous performance in a wide temperature range. Carbonitrides with high nitrogen content provide an unfavorable in-pile restructuring, while carbonitrides with low nitrogen content display a carbide-type restructuring, but with more favorable features. (NL)

25187 OVERVIEW OF THE CLINCH RIVER BREEDER REACTOR PLANT PROJECT. Van Nort, P. S.; Copeland, R. L. (Project Management Corp., Chicago). Proc. Am. Power Conf.; 37: 213-220(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Project status is briefly reported, and a design summary is presented. (DG)

25188 PROTOTYPE COMMERCIAL LMFBR FOR THE UNITED STATES. Sciacca, F. W. (General Electric Co., Sunnyvale, CA); Gibson, A. S.; Nagy, A.; Comprelli, F. A. Proc. Am. Power Conf.; 37: 235-245(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

A joint GE/Bechtel study effort is described which was performed to identify an LMFBR design concept embodying the characteristics and features necessary for the LMFBR to become a commercial reality. (DG)

25189 GCFR DEMONSTRATION PLANT DESIGN AND PROGRAM PROGRESS. Hunter, R. S. (American Electric Power Service Corp., New York); Compas, W. J.; Simon, R. H. Proc. Am. Power Conf.; 37: 246-256(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Progress in the GCFR program is reported, and 300-MWe and 750-MWe Demonstration Plant designs are compared. The GCFR is being developed with the participation and support of a Utility Program, an ERDA Program, and an International Cooperative Program. Both the technology developed for the High-Temperature Gas-cooled Reactor (HTGR), principally in plant systems and components, and the technology of fuel and physics developed for the Liquid-Metal Fast Breeder Reactor (LMFBR) program are being used in the GCFR. The GCFR continues to be of great interest as an alternative breeder. (auth)

25190 PROTOTYPE FAST BREEDER REACTORS OPERATING IN EUROPE AND THE U.S.S.R. Rippon, S. Nucl. Eng. Int.; 20: No. 231, 545-550(Jun 1975).

Experiences in the operation of fast breeder prototype reactors are discussed. The large fast reactors BN350, Phenix, and PFR, have performed well. Some of the problems which have been encountered are discussed. Troubles with the sodium steam generators, which are the most critical components, are considered in relation to the differences in designs. Performance of the instrumentation has been extremely good. Hydrogen detection systems have proved sensitive and reliable for detection of leaks. Also of particular interest are the ultrasonic viewing device on Phenix for inspecting the top of fuel elements immersed in sodium, and the central control room of the PFR plant which is of very advanced design. (UK)

25191 BN 600 STATUS REPORT. Rippon, S. Nucl. Eng. Int.; 20: No. 231, 551-555(Jun 1975).

The 600 MW(e) station BN600 is an important stage in the development of fast breeder reactors in the Soviet Union in that it represents a transition from the R and D phase to that of commercial exploitation of fast reactors. It also involves a change from loop to pool design. In comparison with PFR and Phenix, BN600 is more compact, has primary pumps of greater capacity with only slightly larger intermediate heat exchangers and, the vessel and all internal components are supported from the bottom. Details are given of the reactor, core configuration, fuel assemblies, and radial blanket assemblies. The steam generators which are of modular design, the containment philosophy, and plant layout are discussed. (UK)

25192 AN ANALYSIS OF SODIUM BOILING IN FAST REACTORS. Suchomel, J. (Vyskumny Ustav Energeticky, Jaslovske Bohunice (Czechoslovakia)). Jad. Energ.; 20: No. 12, 404-407(Dec 1974). (In Czech)

A hydrodynamic annular model of sodium boiling in fast reactors, including the description of heat transfer in fuel elements,

was elaborated. Code SODEXP treating the problem in finite differences is considered to be a suitable tool for investigating this phenomenon. The results of the analysis of sodium boiling in the ZRR reactor of the BOR-60 type including power and flow transients are given. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 22765, 24999, 25165, 25166, 25179, 25239, and 25255.

25193 (CONF-760111-1) PROMPT ALPHA AND REACTIVITY MEASUREMENTS ON FAST METAL ASSEMBLIES. Mihalczo, J. T. (Oak Ridge National Lab., Tenn. (USA)). 1976. 52p. Dep. NTIS $5.50.

From US/Japan seminar on fast pulse reactors; Tokai, Japan (19 Jan 1976).

This paper summarizes and reviews the methods of reactivity determination and measurement of the prompt neutron decay, briefly describes the equipment requirements for such measurements for unmoderated and unreflected metal assemblies and presents experimental results to illustrate the methods. The primary reactivity determination methods used have been (1) stable reactor period measurements, which are usually used near delayed criticality to calibrate the reactivity prior to burst initiation, (2) prompt reactor period measurements which are useful to determine the reactivity early in the excursion, (3) inverse kinetics rod drop measurements which obtain the reactivity as a function of time after a rod or reactor component is removed from the assembly, and (4) prompt neutron decay constant measurements from which the reactivity can be obtained if corrections are made for changes in the neutron lifetime. Inverse kinetics and decay constant measurements are usually used below delayed criticality although decay constant measurements have been performed above delayed critical. (auth)

25194 (HEDL-SA-788) HIGH BURNUP INSTRUMENTED IRRADIATION OF BORON CARBIDE (YYO2 EXPERIMENT). Pitner, A. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 24p. (CONF-750607-45). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Boron carbide pellets were irradiated in the EBR-II at temperatures of 1200 to 1600°F to burnups as high as 80 x 10^{20} captures/cm^3. Temperature and gas release from each specimen were continuously monitored during the irradiation. In general, helium release was observed to be high during initial irradiation, then decreased after a burnup of 8 x 10^{20} captures/cm^3. The release rate remained relatively low until burnup exceeded 30 x 10^{20} captures/cm^3, then began increasing slowly. Helium release fractions at the end of the test were generally small, 10 to 20 percent for most of the specimens. Material variables of ^{10}B enrichment, pellet density, and grain size had little effect on helium release. This test demonstrated the capability of FFTF reference boron carbide to perform well to burnups of 80 x 10^{20} captures/cm^3, well beyond the maximum burnup level of 50 x 10^{20} captures/cm^3 anticipated for first core control elements. (auth)

25195 (HEDL-SA-789) Eu_2O_3 AND B_4C WORTH CALCULATIONS IN FAST REACTOR SPECTRA. Daughtry, J. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 47p. (CONF-750607-48). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Work is now in progress to design and fabricate europia (Eu_2O_3) control rods for irradiation testing in one of the early operating cycles of the Fast Test Reactor (FTR). These tests will provide data for evaluating europia as a possible control rod absorber material in fast reactors. Prediction of the reactivity worth of the europia rods is a necessary part of the design process. To improve the accuracy of these predictions, an experiment was performed in the FTR Engineering Mockup Critical (EMC) to determine the relative reactivity worth of Eu_2O_3 and boron carbide (B_4C) in control rod size quantities. Upon completion of the experiment, calculations were performed to obtain reactivity worths for comparison with the measured worths. From this comparison, calculation-vs.-experiment (C/E) bias factors were obtained for use in correcting the computed reactivity worth of europia in the FTR. A brief description of the experiment is presented together with the experimental results, a description of the analytical methods, the calculated results, and a comparison of the calculated and experimental results. Also included are discussions of the effects of resonance self-shielding and mesh spacing on computed absorber rod worths. (auth)

25196 (HEDL-SA-794) PRELIMINARY STUDY OF ADVANCED FTR DRIVER CORES. Rothrock, R. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 15p. (CONF-750607-44). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Results are presented of a series of parametric core analyses undertaken to aid in establishing the design envelope for the FTR advanced driver core. Included is a set of nominal core design parameters selected to serve as a basis for review and further advanced core analysis. An advanced oxide fuel was assumed as the basis for this study, having a linear power capability of 15 Kw/ft. The FTR advanced driver core is to provide the irradiation facilities and environment needed for development and proof-testing of fuel and core materials for advanced LMFBR designs with ratings of 1000 MWe and up, capable of short doubling times. (auth)

25197 (HEDL-SA-1065) FFTF REACTOR ASSEMBLY SYSTEM TECHNOLOGY. Mangelsdorf, T. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 13 Nov 1975. Contract E(45-1)-2170. 32p. (CONF-760303-2). Dep. NTIS $4.00.

From ASME-ANS joint international conference on advanced nuclear energy systems; Pittsburgh, Pennsylvania, United States of America (USA) (13 Mar 1976).

An overview is presented of the FFTF reactor and plant together with descriptions of core components, core internals, core system, primary and secondary control rod system, reactor instrumentation, reactor vessel and closure head, and supporting test programs. (DG)

25198 (HEDL-TME-75-48) HEDL STEADY-STATE IRRADIATION TESTING PROGRAM. Status Report thru February 1975. Cantley, D. A.; Cox, C. M.; Heck, E. N.; Jackson, R. L.; Leggett, R. D.; Washburn, D. F.; Weber, J. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-2170. vp. AT.

A comprehensive description of the Hanford Engineering Development Laboratory steady-state irradiation test program is presented. The results were obtained prior to February, 1975. The design basis for the FFTF fuel pin is described to show the criteria against which the irradiated fuel pin performance is compared. This report is subdivided into technical areas which are relevant to fuel pin performance. These areas include an analysis of mixed-oxide fuel pin thermal performance, analysis of fuel dimensional stability, considerations to allow for cladding wastage, experience with fuel pin cladding breaches, analyses of fission gas release observations, verification of end cap weld and wire wrap performance, and analysis of cesium migration. (auth)

25199 (HEDL-TME-75-115) CORE ENGINEERING. Technical Progress Report, July, August, September 1975. Peterson, R. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-2170. 55p. AT.

Progress is reported in the areas of core physics, radiation and shield analysis, and core design and test management. (auth)

25200 (JAERI-M-6024) γ-RAY SPECTRUM MEASUREMENT IN JAPAN RESEARCH REACTOR NO. 3 USING A PORTABLE Ge(Li) SPECTROMETER. Sakai, E. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1975. 38p. (In Japanese). Dep. NTIS (US Sales Only) $5.00.

A portable Ge(Li) γ-ray spectrometer having 2.6% peak detection efficiency and 3.5 keV energy resolution was made using a 7.5 liter liquid nitrogen dewar. The total weight of the spectrometer including the detector, cryostat, preamplifier, high voltage filter, and 7.5 liter liquid nitrogen Research Reactor No. 3 using the spectrometer. γ-rays from natural radioactive nuclides such as ^{40}K, ^{208}Tl, ^{214}Bi and from ^{60}Co, which was an induced radioactive nuclide of the reactor constructing components, were observed at all the places. During the reactor in operation, γ-rays from ^{41}Ar, the induced radioactive nuclide of argon in air, were observed also at all the places. High-energy γ-rays from the neutron capture reaction in iron and from ^{16}N induced by ^{16}O(n,p)^{16}N reaction in the oxygen in heavy-water coolant were found in the first floor of the reactor room; the former seemed to originate from the monochromator crystals of the neutron diffractometers. Noble gas fission product γ-rays were observed in helium cover gas in the FFD system. Pulse height distributions and counting rates of these γ-rays were shown. (auth)

25201 (JAERI-M-6067) REACTIVITY MEASUREMENT IN A FAR-SUBCRITICAL FAST SYSTEM. II. Mukaiyama, T. (Japan Atomic Energy Research Establishment). Mar 1975. 21p. (In Japanese). Dep. NTIS (US Sales Only) $4.50.

Experiments have been made to obtain the reliable values of reactivity of far subcritical fast systems. Five methods were employed for subcriticality measurement. This report presents the procedure and the results of Neutron Source Multiplication method. Seven subcritical systems of −$2 to −$7 were constructed in the FCA VI-2 B2 assembly using three kinds of 90% and 80% enriched B_4C pin clusters. With 11 detectors placed in and around the assembly, the reactivity of the systems was measured. The discrepancy is large for the values obtained with the detectors in the assembly, however, the detectors far from the assembly give a position-independent result. The effect of local perturbation in the flux distribution (rod-shadowing effects) is taken into account by introducing the position-dependent detection efficiency for the detectors in the assembly (MSM method). The values of the detectors in the assembly come to agree very well with each other after the MSM correction, so the experimental values are obtained with good accuracy, which is consistent rigorously with the reactivity defined. These experimental values, the measured values of detectors far from the assembly and the calculated values agree within 3%. (auth)

25202 CHANGING ROLE FOR THE WUERENLINGEN RESEARCH INSTITUTE. Buob, K. H. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingin, Switzerland). Nucl. Eng. Int.; 20: No. 231, 558-560(Jun 1975).

The Swiss Federal Institute for Reactor Research (EIR) at Wuerenlingen originally began in order to support the development of a heavy water moderated reactor, but the emphasis has moved to international reactor projects and broader areas of energy technology. The organization of the Institute is outlined. Current activities include participation in the German development program for a high temperature reactor with a helium gas turbine, work on minimizing the environmental impact of waste heat, and a carbide fuel development program. The type of work done by each of the different divisions of the Institute is quoted. Reference is made to the three research reactors, Diorit, Saphir and Proteus. New statutes for the Institute were formulated in January 1972, under which services and teaching have become of growing importance. (UK)

25203 THEORY OF SOURCE-SINK METHOD AND ITS APPLICATION FOR TRR FRESH CORE CALCULATION. Huang, S. T.; Tsai, J. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 3, 133-150(Sep 1975).

The concept and theory of the source-sink method are described briefly. The line source-sink concept and the line kernel derived for a finite cylindrical reactor are applied to calculate the effective multiplication factor, relative thermal neutron flux distribution, critical height, and control rod worth of the Taiwan Research Reactor (TRR). A parameters study has been done and limitations are discussed. Some ideas for correction and further development of the present work are suggested. (auth)

25204 SPECTRAL DENSITY MEASUREMENTS WITH A MOCK-UP OF THE FAST FLUX TEST FACILITY REACTOR. Mihalczo, J. T.; Pare, V. K.; Mathis, M. V. (Oak Ridge National Lab., TN). Ann. Nucl. Energy; 2: No. 2-5, 177-191(Jun 1975).

From European-American committee on reactor physics specialist meeting on reactor noise: from critical assemblies to power reactors; Rome, Italy (21 Oct 1974).

Two series of noise analysis measurements that were performed with a mock-up of the Fast Flux Test Facility Reactor (FFTF) are described. The first measurements demonstrated the adequacy of in-core noise analysis measurements for reactivity determinations down to 34 dollars subcritical. In the first series, the reactivity of the mock-up was determined by break-frequency noise analysis (BFNA) over a wide range of reactivities down to 34 dollars subcritical. The results from the BFNA with a pair of detectors in the core agreed with results from the modified source neutron multiplication measurements for reactivities down to 34 dollars subcritical. The purpose of the second series was to determine the feasibility of a new method of determining reactivity by using ^{252}Cf. For these studies, the loading of the mock-up of the FFTF was changed to simulate the initial loading of the reactor. The auto-power spectral densities and the real and imaginary parts of cross-power spectral densities between each detector of a pair and a detector containing ^{252}Cf, and between the pair of detectors were measured simultaneously as a function of frequency for reactivities from 0.8 to 75 dollars subcritical. The results of the second series demonstrated the feasibility of the method by verifying many of the predictions of the theory of this method which determines the reactivity in units of multiplication factors from measurements only for the subcritical state of interest. This determination does not depend on the detection efficiency or inherent source strength. (auth)

25205 NEUTRON PHYSICS EXPERIMENTS IN THE PROTEUS REACTOR. Wydler, P.; Heer, W.; Jermann, M.; Richmond, R.; Seth, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 426-429 (Nov 1974). (In German)

"Proteus" is an experimental reactor associated with the gas-cooled fast breeder reactor project (GCFR). Dimensions of the basic structure are quoted. The fuel is a Pu-U-mixed oxide assembly with a 15% Pu content. Measuring methods for neutron spectra are described. γ activities of fission products have been integrated using a NaI crystal spectrometer. Calculated and experimental data is given for GCFR cores in terms of flux versus energy level in MeV. Future experiments include studies of the influence of water leaks from defective heat exchangers, and heat exchangers. (INIS)

25206 OUTPUT LEVEL OF Rg-1M GEOLOGICAL RESEARCH REACTOR RAISED TO 100 kW. Shchetinin, A. M.; Nikitin, V. N.; Nikolaev, V. A.; Petrov, A. I.; Markovich, S. M.; Sachkov, V. F.; Shentsev, V. T. Sov. At. Energy (Engl. Transl.); 38: No. 2, 122-124(Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 97-98(Feb 1975).

Operational experience of the RG-1M reactor has demonstrated that the power level could be stepped up from 30 to 100 kW without requiring any particular change in the core loading pattern. A program of experimental research efforts aimed at increasing the output of the RG-1M reactor to 100 kW was carried out in April 1972, and the reactor's physical and heat-transfer parameters during the startup period and during the experimental operational run are described. (auth)

25207 CORROSIVE ATTACK ON VVR-M FUEL ELEMENT EXPOSED TO WALL BOILING. Kirsanov, G. A.; Konoplev, K. A.; Pikulik, R. G. Sov. At. Energy (Engl. Transl.); 38: No. 2, 125-127(Feb 1975).

Translated from At. Energ. (USSR); 38: No. 2, 98-100(Feb 1975).

The corrosion resistance of the SAV-I aluminium alloy used in VVR-M fuel cans was studied on a test stand designed to simulate reactor heat transfer conditions. Results indicate that as the temperature of the alloy is increased under wall boiling conditions, the corrosion rate climbs appreciably and is a sensitive function of the pH of the water coolant. (DG)

Production and Materials Testing and Processing Reactors

25208 (JAERI-M-5936) SURVEILLANCE TEST OF THE JMTR CORE COMPONENTS. (Japan Atomic Energy Research Inst., Tokyo). Dec 1974. 37p. (In Japanese). Dep. NTIS (US Sales Only) $5.00.

Surveillance tests for the core components of Japan Material Testing Reactor (JMTR) have been carried out since 1966. Four of the several capsules in the program were removed from the core, and subjected to post-irradiation tests in the JMTR Hot Laboratory. The results are described. JMTR surveillance tests are made to examine the irradiation effects of JMTR core components for fast neutrons, covering the several kinds of materials placed in the high fast-neutron field: beryllium as the reflector, hafnium as the neutron absorber of control rod, 17-4PH stainless steel for a roller spring of the control rod, and 304 stainless steel as the grid plates. (auth)

Propulsion and Package Reactors

25209 (73SD4219(Vol.1)) NUCLEAR ELECTRIC PROPULSION MISSION ENGINEERING STUDY COVERING THE PERIOD APRIL 1971 TO JANUARY 1973. Volume I. Executive Summary. Final Report. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Mar 1973. Contract JPL 953104. 24p. Dep. NTIS $3.50.

For Jet Propulsion Lab., Pasadena, CA.

The results of a mission engineering analysis of nuclear-thermionic electric propulsion spacecraft for unmanned interplanetary and geocentric missions are presented. Critical technologies assessed are associated with the development of Nuclear Electric Propulsion (NEP), and the impact of its availability on future space programs. Specific areas of investigation include outer planet and comet rendezvous mission analysis, NEP Stage design for geocentric and interplanetary missions, NEP system

development cost and unit costs, and technology requirements for NEP Stage development. A multimission NEP Stage can be developed to perform both multiple geocentric and interplanetary missions. Development program costs for a 1983 launch would be of the order of $275 M, including hardware and reactor development, flight system hardware, and mission support. Recurring unit costs for flight NEP systems would be of the order of $25 M for a 120 kWe NEP Stage. Identified pacing NEP technology requirements are the development of 20,000 full power hour ion thrusters and thermionic reactor, and the development of related power conditioning. The resulting NEP Stage design provides both inherent reliability and high payload mass capability. High payload mass capability can be translated into both low payload cost and high payload reliability. NEP Stage and payload integration is compatible with the Space Shuttle. (auth)

25210 (CNLM-3237) FLAT AND OFF-SET FORMING OF CONTROL COOLING TUBES, T-1018185 AND T-1018232. Final Report. Goodin, L. F. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 25 Nov 1960. 7p. Dep. NTIS $3.50.

25211 (CNLM-6291) SNAP-50/SPUR POWERPLANT REQUIREMENTS REPORT. Allen, J. E. (Ed.). (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 May 1965. 195p. Dep. NTIS $7.50.

Declassified 3 Dec 1975.

The SNAP-50/SPUR design requirements are presented for the guidance of component research and development groups. In addition, information required for performing application and mission studies has been included. Component descriptions, performance requirements, design criteria, and applications data are presented for 300 kW(e) and 1200 kW(e) SNAP-50/SPUR reference powerplants using both direct condensing and indirect segmented main heat rejection systems. The over-all goals of the SNAP-50/SPUR development program are a nuclear electric space powerplant with: a net electrical power output of 300 to 1000 kW(e); a powerplant specific weight (unshielded) of 20 lb kW(e); and a lifetime of 10,000 hours in space. The current development program is devoted to the feasibility demonstration of all key components for the 300 kW(e) powerplant, based on a 2.2 MW(t) reactor and a 300 kW(e) power conversion module. The output power level can be extended to 1200 kW(e) by clustering four of the 300 kW(e) power conversion modules with a larger [8 to 10 MW(t)] reactor using the same basic fuel technology and design features of the smaller reactor. The direct condensing main heat rejection system is favored. Studies have shown this to result in a weight saving of about 4 lb/kW(e) over the indirect segmented main heat rejection systems. However, there are still many questions concerning compatibility and orbital startup which must be resolved before a final choice can be made. To minimize the effects of this selection the design of all powerplant components except for the heat rejection system (from turbine exhaust to condensate pump inlet) are identical for both concepts. This results in a slightly higher electrical output for the direct condensing system. (auth)

25212 (CNLM-380) MONTHLY PROGRESS REPORT, OCTOBER 1957. Schmickrath, B. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Nov 1956. Contract AT(11-1)-229. 15p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Aircraft propulsion reactor design performance data and component performance testing results are presented.

25213 (CNLM-722) MONTHLY PROGRESS REPORT, MARCH 1958. Schmickrath, B. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 22 Apr 1958. Contract AT(11-1)-229. 17p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Progress is reported in the areas of propulsion system performance studies, reactor component design and performance characteristics, and chemistry and metallurgy studies.

25214 (CNLM-2239(Vol. 3)) POTENTIAL SUBCONTRACTORS' TECHNICAL PROPOSALS FOR DESIGN STUDY AND DEVELOPMENT 310 KW NUCLEAR-MECHANICAL POWER SYSTEM. (Westinghouse Electric Corp., Lima, Ohio (USA)). Jan 1960. 221p. Dep. NTIS $7.75.

Design concepts are proposed for a nuclear space power system. Included are specifications for the electrical generator, control and protection systems, and cooling systems.

25215 (CNLM-2388) PROPOSAL PROGRAM. (Westinghouse Electric Corp., Lima, Ohio (USA)). 18 Mar 1960. Contract AT(11-1)-229. 117p. Dep. NTIS $5.50.

Declassified 9 Jan 1976.

Research and development program budget data are presented for AEC contract AT(11-1)-229 involving airplane propulsion reactors. Fiscal years 1960, 1961, 1962 are included.

25216 (CNLM-2534) PWAR-1C HEAT EXCHANGER IB2. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1960. 3p. Dep. NTIS $3.50.

Declassified 12 Dec 1976.

Specifications are given for the PWAR-2C Li–NaK heat exchanger IB2.

25217 (CNLM-4026) BUDGET ESTIMATE FOR FISCAL YEAR 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 18 Apr 1962. Contract AT(30-1)-2789. 52p. Dep. NTIS $4.50.

Declassified 12 Jan 1976.

The SNAP 50 research program is described, and program cost data are presented.

25218 (CNLM-5373) PARAMETRIC DESIGN STUDIES AND PHYSICS DEVELOPMENT. Weekly Progress Report, Week Ending November 15, 1963. Kennedy, W. G. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Nov 1963. Contract AT(30-1)-2789. 4p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Included are comments on reference reactor physics calculations, general reactor calculations, shield analysis, and critical experiments on SNAP-50 and MCR.

25219 (CNLM-5492) SYSTEMS INTEGRATION GROUP WEEKLY REPORT, JANUARY 27–31, 1964. Meyer, R. M. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Jan 1964. 3p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Reference powerplant design studies are described, and powerplant performance and space applications are discussed.

25220 (CNLM-6000) WEEKLY PROGRESS REPORT, NOVEMBER 16–20, 1964. Parks, G. U. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 24 Nov 1964. 6p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Progress is summarized in reactor design studies and component development tests.

25221 (COM-75-10513) ISSUES OF FINANCIAL PROTECTION IN NUCLEAR MERCHANT SHIP OPERATIONS. Final Report, June 1974–January 1975. Murphy, A. W. (Atomic Industrial Forum, Inc., New York (USA)). 27 Mar 1975. Contract MA-4-37122. 95p. NTIS $4.75.

Adequate financial protection against liability for builders and operators of nuclear powered merchant ships is a significant element in establishment of a viable nuclear merchant ship program. Questions of liability, insurance and indemnity as they might affect the construction and operation of nuclear ships and requirements of a legislative package which would assure adequate protection of the public in the remote event of a nuclear ship accident are examined. (GRA)

25222 (GKSS-75/E/12) NS OTTO HAHN TEST REPORT NO. 24 FOR THE TIME BETWEEN 11-4-1974 AND 28-1-1975. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1975. 46p. (In German). INIS.

10 figs.

The travelogues—which consists of nautical and technical remarks—are supplemented by performance diagrams of each voyage. The work done from April 11th to May 5th, 1974, when the ship was moored, and research activities on reactor dynamics are also reported. (DE)

25223 (MDC-G-4443) COMPARATIVE BEHAVIOR OF PLUTONIA-238 BASE FUEL FORMS WITH AND WITHOUT CURIA-242 ADDITIONS. Watrous, J. D.; Andelin, R. L.; Walker, J. C.; Ferguson, W. E. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Jan 1975. Contract AT(45-1)-2138. 57p. Dep. NTIS $4.50.

Mechanical behavior of plutonium-238 oxide and cermet radioisotope fuel forms during reentry from space operation is expected to be dependent upon the age of the fuel. A program to determine aging effects by accelerating helium generation is described. The results, the problems encountered, and the conclusions relevant to heat source technology determined during this fuel aging program are discussed.

25224 (NASA-CR-54032) INVESTIGATION OF CAVITATION DAMAGE OF MECHANICAL PUMP IMPELLERS OPERATING IN LIQUID METAL SPACE POWER LOOPS. Quarterly Progress Report No. 3, January 2, 1964–March 31, 1964. Kulp, R. S.; Altieri, J. V. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Apr 1964. Contract NAS3-2541. 21p. (CNLM–5208). Dep. NTIS $3.50.

Water testing of the TP-1 turbopump in the PT-4 Water Pump Test Stand was completed during the quarter. The data obtained showed good agreement with the impeller tests conducted in the PT-2 test stand. The five flowrates investigated during the impeller tests (reported in CNLM-5205) were repeated for evaluating cavitation performance of the turbopump. The pump scroll losses were very low and closely approximated the losses of the vaneless diffuser in the previous impeller tests for non-cavitating operation. Scroll effects were more evident in cavitation testing for the higher flowrates at relatively high NPSH (on the order of 35 feet). (auth)

25225 (NVO-164) SAFETY ANALYSIS REPORT FOR TORY II-C FUEL RECOVERY. Bond, A. L. (Energy Research and Development Administration, Las Vegas, Nev. (USA). Nevada Operations Office). 12 Sep 1975. 75p. Dep. NTIS $5.00.

The following activities are examined: (1) transfer by rail of the reactor from the present storage location in the Reactor Maintenance, Assembly and Disassembly (R-MAD) building to the Engine Maintenance, Assembly and Disassembly (E-MAD) building, a distance of approximately five miles; (2) the disassembly of the Tory II-C assembly to permit removal of the reactor core in the E-MAD building; (3) the disassembly of the reactor core into individual fuel tubes, also referred to as fuel rods; and (4) the packaging of the tubes for shipment to the Idaho National Engineering Laboratory (INEL). Included are descriptions of organizational responsibilities, facilities and equipment, operations, radiological safety, nuclear safety, industrial hygiene, industrial safety, accident evaluation, and emergency plan.

25226 GOING NUCLEAR IN THE SHIPYARDS. Schnegelsberg, W.; Bianchi, H. K. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). Nucl. Act.; No. 12, 26-32(Jan 1975).

Nuclear powered ships are the emerging answer to the present-day impasse of soaring fuel oil prices. This is the conviction of West Germany, increasingly shared by other maritime countries. (INIS)

Reactor Safety and Environmental Aspects

Refer also to abstracts 23304–23306, 23321, 23471, 23482, and 23874.

25227 (AD/A-009498) ANALYSIS AND CONCEPTUAL DESIGN OF PRACTICAL ICE-WATER HEAT SINKS. Special Report. Grande, E. (Foster-Miller Associates, Inc., Waltham, Mass. (USA)). Mar 1975. Contract DAAG17-73-C-0238. 163p. NTIS $6.25.

The study considers the analysis and conceptual design of an ice-water heat sink for use with a 1500 kW nuclear power plant applicable to hardened underground installations. The purpose of the heat sink is to contain the waste heat from the power system during a period in which the installation is completely sealed off from dependence on any surface facilities. An ice-water heat sink system is a very attractive concept due to the large amount of heat associated with the melting of ice. This study is intended to provide information on configuration parameters and system performance to permit development of a practical system design. Two alternative heat sink configurations are recommended for the prototype design: an annular flow heat sink and a top surface melting heat sink. A high level of confidence is placed in the predicted performance of the annular flow configuration. The top surface melting configuration is considered superior in terms of meeting the design objectives, but its predicted performance is based on assumptions that, although reasonable, must be verified by experiments. (GRA)

25228 (AERE-R-7992) RS 133: THE QUENCHING OF HOT SURFACES BY TOP AND BOTTOM FLOODING: A REVIEW. Butterworth, D.; Owen, R. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1975. 51p. Dep. NTIS (US Sales Only) $4.50.

After a loss of coolant accident in a nuclear reactor, the fuel elements can become seriously overheated and have therefore to be quenched with water. In different reactor systems, water may be introduced from the top or the bottom of the core, or by spraying from sparge pipes running the length of the fuel bundle. The published information on quenching with both top and bottom flooding and with spraying is reviewed. The experimental data are reviewed and compared, and the various theoretical treatments presented. Recommendations are made as to the best prediction methods currently available and as to future work which may be required to improve knowledge and understanding of the subject. Some of the main conclusions are that further parametric studies of top and bottom flooding are required (particularly for bottom flooding), that more fundamental measurements are necessary to elucidate the sputtering mechanism and that tube wall conduction theories serve a useful basis for analyzing the data despite the unreality of some of the boundary conditions used in the modeling. (auth)

25229 (ANL-Trans-1042) PARASEISMIC PRECAUTIONS FOR NUCLEAR REACTORS. Costes, D. 1971. Translation of Precautions Parasismiques pour les Reacteurs Nucleaires. 34p. Dep. NTIS $4.00.

A paper is presented whose purpose is to present, in a brief manner, the essential facts of the seismological and paraseismological techniques, while showing the derivations and the research problems that lead to construction site choices. (auth)

25230 (BNL-50477) THERMOHYDRAULIC LMFBR SAFETY EXPERIMENTS. Quarterly Report, July-September 1975. Kazimi, M. S.; Chen, J. C.; Gustavson, W. R. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1975. Contract E(30-1)-16. 21p. Dep. NTIS $5.00.

Progress is reported in the following areas: heat-generating boiling pool phenomena, streaming/freezing phenomena in flowing fluids, and temperature dependence of electric resistivity of salt solutions. (JWR)

25231 (CENPD-107(Suppl. 4)) ATWS MODEL MODIFICATIONS TO CESEC. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Dec 1975. 79p. Combustion Engineering, Inc., Windsor, CT.

Descriptions are presented of all significant modifications to the CESEC computer code which have been made since September, 1974, for application to analysis of ATWS events in a C–E Nuclear Steam Supply System. These modifications include reformulation of the analytical descriptions of the mass and energy conservation in the reactor coolant in both the reactor coolant system loops and the pressurizer; improvement of the conduction, convection, and boiling heat transfer models; improvement of the Doppler and void reactivity feedback models; and improvement of the steam generator dryout model. The report also includes descriptions of the verification of the CESEC reactivity feedback model using three-dimensional neutron diffusion calculations and specification of fuel damage criteria. Also included are modifications of certain responses to NRC questions concerning C–E's ATWS evaluation methods previously submitted by C–E and responses to all NRC questions not previously submitted. 15 references. (auth)

25232 (CENPD-158) ANTICIPATED TRANSIENTS WITHOUT REACTOR TRIP. (Combustion Engineering, Inc., Windsor, Conn. (USA)). 1974. 149p. Combustion Engineering, Inc., Windsor, CT.

The analytical methods, computer codes, transients selected, and results of transients analyzed for Combustion Engineering PWR systems are presented. (JWR)

25233 (CENPD-213) APPLICATION OF FLECHT REFLOOD HEAT TRANSFER COEFFICIENTS TO C–E's 16 x 16 FUEL BUNDLES. Holderness, J. H. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jan 1976. 11p. Combustion Engineering, Inc., Windsor, CT.

NRC has approved a FLECHT based reflood heat transfer correlation (designated MOD-1C) for use on the C–E 14 x 14 fuel assembly. A procedure for applying the MOD-1C correlation to the C–E 16 x 16 fuel assembly is proposed. The procedure applies a correction factor to the MOD-1C correlation. This correction factor accounts for the geometric differences between the 14 x 14 and 16 x 16 fuel assemblies. Comparison with experimental data corroborates the applicability of the correction method. Thus, C–E requests approval to use the MOD-1C correlation with the geometric correction factor in ECCS analyses on plants having 16 x 16 fuel assemblies. A computer program called THERM is described which presents a physical model of the reflood heat transfer process. This program was employed to establish the significant parameters involved in the geometric correction factor. Thus, the acceptability of the correction factor is based on the comparisons with experimental data rather than on the THERM program. (auth)

25234 (ERDA-70) ENVIRONMENTAL IMPACT OF ELECTRICAL POWER GENERATION: NUCLEAR AND FOSSIL. Teacher's Guide. (Pennsylvania Dept. of Education, Harris-

burg (USA)). 1975. Contract AT(40-2)-4167. 27p. Dep. NTIS $4.00.

The major goal of this minicourse is to have students gather pertinent information on the need for and generation of electrical energy, then make their own judgments on whether a need exists and, if so, how the need can best be filled. The students must be made aware of the advantages and disadvantages of each method of electrical generation without the teacher unduly emphasizing one method. The educational objectives, suggested activities and other pertinent material are presented for each chapter. (CH)

25235 (GA-A-13727) CONTAINMENT ATMOSPHERIC RESPONSE (CAR) SCOPING STUDY. Del Bene, J. V.; Deremer, R. K.; Landoni, J. A. (General Atomic Co., San Diego, Calif. (USA)). Dec 1975. Contract E(04-3)-167. vp. Dep. NTIS $4.00.

The primary objectives of the Containment Atmospheric Response (CAR) subtask are to identify and evaluate thermodynamic phenomena occurring in the containment atmosphere during postulated gas-cooled reactor depressurization events that may affect the release of fission products to the environment. The release of fission products to the environment can be altered if the containment function fails, if the amount of plateout in the containment is changed or if the performance of the containment atmospheric cleanup system is impaired. A knowledge of the blowdown phenomena can also provide guidelines for locating reactor shutdown equipment and establishing requirements for the CACS. (auth)

25236 (GEAP-14038-4) ADVANCED SAFETY ANALYSIS, Fourth Quarterly Report, June–August, 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1975. Contract E(04-3)-893. 103p. AT.

Included are progress summaries in the areas of LMFBR engineering analysis of post-accident heat removal, inherently safe core design, fuel pin failure mechanisms, and safe shutdown reliability for a commercial LMFBR.

25237 (GERRSR-1) PUMP BEHAVIOR IN THE INTACT PIPE DURING BURST OF A PARALLEL LINE. 1974. Translation of BMFT-RS-92. 74p. Dep. NTIS $4.50.

Work performed under United States Nuclear Regulatory Commission–Light Water Reactor Safety Technical Exchange Program.

Studies are reported which were carried out to investigate supercavitation behavior of PWR circulation pumps under single-phase flow and blowdown conditions. Results are presented and interpreted. (DG)

25238 (HEDL-SA-781) FAILURE THRESHOLD CORRELATION FOR FAST REACTOR TRANSIENT OVERPOWER ACCIDENT ANALYSIS. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 12p. (CONF-750607-47). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

One important aspect in analysis of the transient overpower accident for an LMFBR is the prediction of time and location of fuel pin failure. A great deal of effort has been and is being devoted to the mechanistic prediction of fuel pin failure threshold; however, it is anticipated that some time will yet pass before a generally accepted model is available. For the interim, it appears desirable to continue development and use of empirical correlation of failure thresholds. Such development has been pursued at Westinghouse Hanford for about two years now, and shows promise of near term usefulness. A brief description is given of the evolution of this effort at Westinghouse Hanford. The most recent correlation that has been developed is presented together with a discussion of the manner in which it is applied. Some of the more recent developments are mentioned. (auth)

25239 (HEDL-SA-909) FFTF TRANSIENT OVERPOWER ACCIDENT: A PERSPECTIVE. Waltar, A. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 34p. (CONF-750607-43). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A brief reflection on the current understanding of the unprotected transient overpower accident is presented and an attempt to place it into perspective with regard to the overall question of the FFTF core energetics. (auth)

25240 (JAERI-M-5981) GTOROTO-3, -4; SEISMIC SIMULATION PROGRAM USING GRAPHIC DISPLAY FOR BLOCK-TYPE FUEL HTGR CORE. Ikushima, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Feb 1975. 31p. (In Japanese). Dep. NTIS (US Sales Only) $5.00.

Computer program GTOROTO-3, -4 has been prepared for the simulation of the seismic response of a block-type fuel HTGR core, using a graphic display. Features of the program are as follows: (1) Behavior of the block-type fuel HTGR core in earthquake can be represented on a CRT of the graphic display. (2) Parameters for the graphic representation can be changed with a light-pen. (3) Routines of the computing scheme can be changed with the light-pen or an alteration switch. (4) The simulation pictures are presented automatically. The hardcopy can be fixed on a plotter by stopping the progress of simulation pictures. The graphic representation can be restarted according to the predetermined program. (5) Information of graphic pictures can be stored using the assembled language on a disk for obtaining a rapid representation. (auth)

25241 (JAERI-M-6073) MODEL EXPERIMENTS ON Na POOL FIRE. Furukawa, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1975. 116p. (In Japanese). Dep. NTIS((US Sales Only) $6.50.

In Na-cooled Fast Breeder Hazard Analysis for a Na pool fire in the reactor containment vessel, Na fire model experiments have been carried out with a 3.2 m^3 closed vessel of height 2 m and diameter 1.5 m. The burning areas used are 0.3, 0.15 and 0.075 m^2. For the different initial Na temperatures, initial oxygen contents and atmospheric humidities, the burning rate was estimated from change of the oxygen content in the atmosphere, gas density or generated heat. The Na surface burning rate of initial temperature 500°C in the closed air with 21 v/o oxygen depends strongly on the ratio of Na surface area and sectional (bottom) area of the reaction vessel. The apparent burning rate is nearly constant. Below 5 v/o oxygen, at least, the mild oxidation without brightness proceeds in first-order reaction with the oxygen content. (auth)

25242 (JAPFNR-200) PRELIMINARY RESULTS OF GAS INJECTION INTO SODIUM FLOWING IN A 37-PIN BUNDLE. Haga, K.; Kikuchi, Y.; Daigo, Y. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Sep 1975. 8p. (CONF-751081-3; N-943-75-04). Dep. NTIS (US Sales Only) $3.50.

From 6th liquid metal boiling working group meeting; Risley, United Kingdom of Great Britain and Northern Ireland (UK) (1 Oct 1975).

Work performed under United States–Japanese Fast Reactor Exchange Program.

Out-of-pile experiments were conducted to evaluate the thermal and hydrodynamic effects due to gas injection into sodium flowing in a 37-pin bundle, which consisted of a central gas-injection pin, seven electrically heated pins and other dummy pins. Thermocouples were installed on the cladding of heated pins. The first series of experiments were carried out without gas injection to establish base cases and to evaluate the effect of mixing due to spacer wires. The experimental results agreed well with the predictions by the NORMAL code which considers the effect of mixing due to spacer wires. The second series of experiments were conducted by injecting argon gas transiently or continuously through a small nozzle (0.2 approximately 0.3 mm in diameter) of the gas-injection pin. In the transient injection experiment rapid temperature rises due to gas blanketing were observed on the surfaces of the heated pins at the axial position where gas was injected. In the continuous injection experiments, however, the measured wall temperature rises were small and well within tolerable limits. (auth)

25243 (JAPFNR-201) ACOUSTIC NOISE WITH SODIUM BOILING IN A SEVEN-PIN BUNDLE. Kikuchi, Y.; Daigo, Y.; Haga, K. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Aug 1975. 9p. (CONF-751081-1; N-943-75-03). Dep. NTIS (US Sales Only) $3.50.

From 6th liquid metal boiling working group meeting; Risley, United Kingdom of Great Britain and Northern Ireland (UK) (1 Oct 1975).

Work performed under United States–Japanese Fast Reactor Exchange Program.

The acoustic noises associated with sodium boiling in a seven-pin bundle, six central channels of which were blocked, are discussed. The acoustic intensity first increased with rise in the heat flux, and after attaining a maximum, decreased somewhat to remain more or less constant thereafter. At the final upstream voiding which resulted in the dryout, however, the acoustic intensity increased sharply. The frequency spectrum did not change markedly during boiling. Distinct peaks observed in the high frequency range for all the measurements could well be related to the characteristics of the resonances of the experimental system which is not the waveguide, but the test section and/or the expansion tank. On the other hand, the peak observed at the low

frequency was due to the repetition of bubble formation and collapse. (auth)

25244 (JAPFNR-202) LOCAL TEMPERATURE RISE DUE TO A 6-CHANNEL BLOCKAGE IN A 7-PIN BUNDLE. Daigo, Y.; Haga, K.; Ohtosubo, A.; Kikuchi, Y. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Sep 1975. 8p. (CONF-751081-2; N-943-75-05). Dep. NTIS (US Sales Only) $3.50.

From 6th liquid metal boiling working group meeting; Risley, United Kingdom of Great Britain and Northern Ireland (UK) (1 Oct 1975).

Work performed under United States–Japanese Fast Reactor Exchange Program.

An experimental study was performed of local temperature rises due to a non-heat-generating blockage in an electrically heated 7-pin bundle. Each pin was 6.5 mm in diameter and had a 450 mm heated length. The pitch-to-diameter ratio (P/D) was 1.22. The bundle was inserted in a hexagonal duct. The central six channels in the bundle were blocked by a 0.5 mm thick stainless steel plate at 350 mm downstream from the start of the heated section. The temperature distributions were measured by the thermocouples which were mostly located downstream from the blockage. The experimental conditions were as follows. Coolant velocity: 0.37 approximately 5.00 m/s, Linear heat rate: 8.5 approximately 127.2 w/cm, and Inlet coolant temperature: 298 approximately 296^{0}C. The hottest surface temperature of the central pin was observed immediately downstream from the blockage. The measured temperature rise was approximately two thirds of the predicted value by the LOCK code, in which the presence of a stagnation behind the blockage was assumed. When applying the experimental results to reactor conditions, the temperature rise due to a 6-channel blockage is considered to be less than 130^{0}C.

25245 (KFK-2196) SODIUM LOOP FACILITY FOR INVESTIGATION OF FUEL SODIUM INTERACTION BY MEANS OF ELECTRICALLY HEATED UO_2 RODS. Deckers, H.; Drexler, H.; Lehning, H.; Piel, D.; Reiser, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Oct 1975. 40p. (In German). Dep. NTIS (US Sales Only) $4.00.

An out of-pile test facility has been erected for investigation of the fuel-sodium interaction taking place after power excursion. This facility allows melting down of up to 7 fuel pins arranged in bundles through direct electric heating in flowing sodium. The maximum active UO_2 length in the fuel pin is 160 mm. The cooling and hydraulic conditions in the test section have been chosen similar to that in the SNR fuel element, although they are variable. In the course of testing 27 measuring values at the maximum are recorded in an analog mode on magnetic tape. They are digitized and evaluated using the SEDAP program system. The loop facility started operation in April 1975. A first test series relating to single pins and 7-pin bundles is presently being conducted. (auth)

25246 (KFK-2197) ELEKTRA: A COMPUTER PROGRAM FOR TEMPERATURE DISTRIBUTION IN A UO_2 ROD WITH DIRECT ELECTRIC HEATING AT TRANSIENT OVERPOWER. Piel, D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Dec 1975. 42p. (In German). Dep. NTIS (US Sales Only) $4.00.

At the Institute of Materials and Solid State Research experiments are carried out by melting of electrically heated fuel pins, which relate to fuel-sodium interactions during reactivity accidents. The development of the power transient must be known when planning the conduct of the experiment. For this purpose, the FORTRAN computer program ELEKTRA was developed which calculates the distributions of temperature and power density in the UO_2 fuel pin taking into account the temperature dependence of the electric resistance. The computation model for the fuel pin and the thermodynamic basic equations used are described. A new relation is indicated for the development of the electric resistivity of UO_2 calculated from a multitude of data obtained in experiments. Finally, program input and output are described with an actual arithmetical example. The results are compared with the measured values of the experiment. (auth)

25247 (LA-6217-MS) DEVELOPMENT OF THIN SHELL EQUATIONS FOR REACTOR SUBASSEMBLY DYNAMICS. DeVault, G. P.; Blewett, P. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1976. Contract W-7405-Eng-36. 12p. Dep. NTIS $4.50.

By means of Hamilton's principle the elastic equations of motion for thin cylindrical shells are developed. Explicitly included in these equations are the possibilities of loading due to interior pressure pulses and to thermal stresses. A test problem is considered for the case of a uniform pressure pulse traveling along the axis; an exact analytic solution is compared with the results found by a finite-difference method. The two solutions agree within 1 percent; which agreement is satisfactory for present purposes.

25248 (LA-UR-76-241) FLASH X-RAY CINEMATOGRAPHY. Stein, W. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1976. Contract W-7405-eng-36. 26p. (CONF-751141-6). Dep. NTIS $4.50.

From meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

Experiments intended to provide an overview of the potential capabilities and limitations of flash x-ray cinematography as a diagnostic technique for a Fast Reactor Safety Test Facility are described. The results provide estimates of the x-ray pulse intensity required to obtain adequate radiographs of an array of fuel pins in a typical reactor configuration. An estimate of the upper limit on the pulse duration imposed by the reactor background radiation was also determined. X-ray cinematography has been demonstrated at a repetition rate limited only by the recording equipment on hand at the time of these measurements. These preliminary results indicate that flash x-ray cinematography of the motion of fuel in a Fast Reactor Test Facility is technically feasible. (auth)

25249 (MRR-151) BRUFRI—A PROGRAM FOR THE RECALCULATION OF FREON-12-BLOWDOWN EXPERIMENTS. Benedek, S.; Steinhoff, F. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jun 1975. 47p. (In German). INIS.

12 figs.; 1 tab.; 21 refs.

On the basis of the blowdown code BRUCH-S-02 a program (BRUFRI) has been developed, with which post test predictions for the Freon-12-blowdown experiments at the "Institut fuer Verfahrenstechnik der Technischen Universitaet Hannover" may be calculated. Problems were encountered in developing the subroutine for the properties of Freon-12, as they are partly unknown in the range which was required. Such gaps could only be closed by using approximative solutions or good estimations according to the water properties. The results of a first post test prediction were satisfactory. The code BRUFRI can also contribute to the analysis of similarity laws between Freon-12 and water, as it is very simple to double the code and to replace the data and subroutines for Freon-12 by the corresponding ones for water. (DE)

25250 (NEDO-20566(Vol. 1)) GENERAL ELECTRIC COMPANY ANALYTICAL MODEL FOR LOSS-OF-COOLANT ANALYSIS IN ACCORDANCE WITH 10CFR50 APPENDIX K. Volume I. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Jan 1976. 361p. General Electric Co., San Jose, CA.

Documentation for General Electric Company analytical models for predicting BWR response to postulated loss-of-coolant accidents is presented. (JWR)

25251 (NEDO-20566(Vol. 2)) GENERAL ELECTRIC COMPANY ANALYTICAL MODEL FOR LOSS-OF-COOLANT ANALYSIS IN ACCORDANCE WITH 10CFR50 APPENDIX K. Volume II. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Jan 1976. 381p. General Electric Co., San Jose, CA.

Documentation for the General Electric Evaluation Model is presented. Computer codes and numerical methods common to the codes are described. It is shown how GE BWR's conform to the Acceptance Criteria of 10CFR50.46. (JWR)

25252 (NP-20784) POST-FAILURE PHENOMENA IN LMFBR TOP ACCIDENTS. Quarterly Progress Report, July 1, 1975–September 30, 1975. Erdman, C. A.; Reynolds, A. B. (Virginia Univ., Charlottesville (USA). Dept. of Nuclear Engineering). 1975. Contract AT(49-24)-0158. 6p. Nuclear Regulatory Commission, Washington, DC.

First quarter efforts were concentrated on large-scale fission gas voiding, 2D aspects of intrasubassembly voiding, and implementation of PLUTO on the UVa. computer. (auth)

25253 (NTIS/PS-75/659) ACCIDENT RISKS IN NUCLEAR FACILITIES (A BIBLIOGRAPHY WITH ABSTRACTS). Period Covered: 1964–August 1975. Grooms, D. W. (National Technical Information Service, Springfield, Va. (USA)). Aug 1975. 177p. NTIS $25.00.

The bibliography presents risk analysis and hazards evaluation of the design, construction and operation of nuclear facilities including the risk and hazards of transporting radioactive materials to and from these facilities. Radiological calculations for environmental effects of nuclear accidents are included. (Contains 131 abstracts) (NTIS)

25254 (ORNL-TM-4875(Add. 1)) WORK PLAN: TRANSIENT RELEASE FROM LMFBR FUEL. Addendum 1. Investigation of LMFBR Aerosol Behavior in the Aerosol Test Facility. Parsly, L. F. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 19p. Dep. NTIS $4.50.

The justification, objectives and scope, technical approach, proposed experiments, and program schedule for the aerosol release and transport program are presented.

25255 (ORNL/TM-5101) TEMPERATURE DISTRIBUTION IN A 19-ROD SIMULATED LMFBR FUEL ASSEMBLY WITH A SIX-CHANNEL INTERNAL BLOCKAGE (FUEL FAILURE MOCKUP BUNDLE 3A): RECORD OF EXPERIMENTAL DATA. Fontana, M. H.; Gnadt, P. A.; Kress, T. S.; MacPherson, R. E.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. W-7405-eng-26p. AT.

Experimental data are presented for Fuel Failure Mockup bundle 3A, which simulated the configuration and power level of the Fast Test Reactor fuel. Bundle 3A consisted of 19 electric cartridge heaters with outside diameters of 0.230 in. spaced by 0.056-in. wire wraps on a 12-in. pitch. A stainless steel plate attached to the central rod blocked the six central channels 15 in. downstream from the start of the heated section. The purpose of this test series was to obtain the thermal-hydraulic effects of this internal blockage in a simulated Fast Test Reactor core. A description of the experimental procedures, a discussion of the data-reduction procedures, and tabulated data from experiments performed in this series are presented. (auth)

25256 (ORNL-TM-5117) BLOWDOWN HEAT TRANSFER PROGRAM. Quarterly Progress Report, July–September 1975. Thomas, D. G.; Hedrick, R. A. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 86p. Dep. NTIS $5.45.

Progress is summarized in the areas of two-phase flow instrumentation studies, forced-convection test facility operation, program planning and analysis, thermal-hydraulic test facility operation, thermal hydraulic test facility instrumentation, and heater rod procurement and development.

25257 (ORNL-TM-5143) FISSION PRODUCT RELEASE FROM LWR FUEL. Quarterly Progress Report July–September 1975. Malinauskas, A. P.; Lorenz, R. A.; Osborne, M. F.; Collins, J. L.; Manning, S. R. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

Control experiments involving methyl iodide, cesium oxide, and cesium iodide are described together with fission gas release from high-burnup fuel and Knudsen cell studies.

25258 (ORNL-TM-5148) ZIRCONIUM METAL–WATER OXIDATION KINETICS PROGRAM SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH. Quarterly Progress Report, July–September 1975. Cathcart, J. V. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 32p. Dep. NTIS $4.00.

Additional diffusivity data for oxygen in beta-Zircaloy-4 were obtained. Similar measurements at 1000, 1200, and 1400°C in beta-zirconium and beta-Zircaloy-2 agreed well with previously obtained data for diffusion in Zircaloy-4. Published oxidation rate and diffusivity data were analyzed statistically, and, where appropriate, the results were compared with these data. Improvements in reaction rate measuring instruments are described along with new experimental results bearing on the problem of specimen self-heating during oxidation. The previously reported line of pores in high-temperature oxide scales on Zircaloy was shown to be a polishing artifact; the apparent pores are actually metal particles that are rich in tin.

25259 (ORNL-TM-5149) CREEPDOWN AND COLLAPSE OF ZIRCALOY FUEL CLADDING PROGRAM SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH. Quarterly Progress Report, July–September 1975. Hobson, D. O. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

The creepdown and collapse study on Zircaloy fuel cladding is concerned with the deformation behavior of cladding under normal and near-normal reactor operating conditions. Progress is summarized in the areas of: equipment development, tubing characterization, and collapse testing. Eddy-current deformation-monitoring instrumentation is presently being modified to provide multisignal recording capability for use with the multiple-coil configurations required in the various collapse and creepdown tests. Characterization studies of the specimen tubing have involved dimensional inspection, hardness measurements, and x-ray texture determination. Initial collapse tests have been run and have shown the 80 percent cold-worked, as-received tubing to be stronger than expected from previously published data. A series of annealing experiments has been added to the test matrix because of this high strength level. Tests conducted with mandrels to simulate a pellet-to-pellet gap show the tubing to obey the von Mises collapse equation in that the number of collapse lobes or nodes increases with decreasing pellet gap.

25260 (ORNL-TM-5154) MULTIROD BURST TEST PROGRAM. Quarterly Progress Report, July–September 1975. Chapman, R. H. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. 44p. Dep. NTIS $5.50.

Progress is summarized in the areas of program plans and analysis; development and procurement; design, fabrication, and construction; and operation.

25261 (ORNL-TM-5156) FISSION PRODUCT BETA AND GAMMA ENERGY RELEASE. Quarterly Progress Report, July–September 1975. Dickens, J. K.; Love, T. A.; McConnell, J. W.; Emery, J. F.; Peelle, R. W. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

Preliminary data for gamma-ray energy release from fission product decay following thermal-neutron fission of ^{235}U has been obtained and reduced for cooling times between 3 and 14,400 sec. The data were obtained as pulse-height spectra for photon energies between 0.05 and 8 MeV using a NaI spectrometer and were unfolded to give photon-energy spectra of moderate resolution. The data are presented in graphical form for 27 combinations of irradiation, cooling, and counting times. Two irradiation times, t/sub i/ equals 2.4 and 100.4 sec, were studied. The energy release values were obtained by integrating the spectra. In addition, photon yield data were obtained for E/sub gamma/ between 0.025 and 0.05 MeV; they contribute insignificantly to the total energy release. Preparations for beta-ray energy release measurements involved detailed study of the beta-ray detector's response and additional studies of electron scattering from various source configurations to arrive at an optimal design for the sample holder.

25262 (ORNL/TM-5263) MONTHLY HIGHLIGHTS FOR OFFICE OF NUCLEAR REGULATORY RESEARCH PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 25p. Dep. NTIS $5.00.

Brief highlights are presented for the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, NSIC, PWR blowdown heat transfer-separate effects, zircaloy fuel cladding collapse, zirconium metal-water oxidation kinetics, aerosol release from LMFBR fuel, HTGR safety analysis and research, and design criteria for piping and nozzles. (JWR)

25263 (ORNL/TM-5294) JANUARY 1976 MONTHLY HIGHLIGHTS FOR OFFICE OF NUCLEAR REGULATORY RESEARCH PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 27p. Dep. NTIS $4.00.

Technical highlights and cost/budget data are presented for the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, Nuclear Safety Information Center, PWR blowdown heat transfer-separate effects, Zircaloy fuel cladding collapse studies, zirconium metal-water oxidation kinetics, aerosol release and transport from LMFBR fuel, HTGR safety analysis and research, and design criteria for piping and nozzles.

25264 (REG/G-1.92(Rev.1)(2-76)) COMBINING MODAL RESPONSES AND SPATIAL COMPONENTS IN SEISMIC RESPONSE ANALYSIS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Feb 1976. 5p NUREG.

25265 (REG/G-1.27(Rev.2)(1-76)) ULTIMATE HEAT SINK FOR NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Jan 1976. 5p. NUREG.

An acceptable basis for implementing design criteria concerning ultimate heat sinks utilizing water sources is presented. (JWR)

25266 (RT/ING-(75)15) DOLCE: A CHANNEL COMPUTER PROGRAM IN THE THERMO-HYDRAULIC ANALYSIS OF BWR TRANSIENT CONDITIONS. Marinelli, V.; Vitanza, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1975. 55p. (In Italian). Dep. NTIS (US Sales Only) $4.50.

The DOLCE computer program, written in FORTRAN IV language for the IBM 360 system, evaluates the thermo-hydraulic behavior of a boiling channel under transient conditions of power, flow rate, pressure, inlet enthalpy. It is particularly useful to analyze the accidental conditions (as LOCA, reactivity insertion

etc.) which may occur in a BWR reactor. The time to first CHF and the CHF axial propagation are evaluated and calculations are performed for the cladding and fuel temperatures in the pre-crisis and post-crisis regions. (auth)

25267 (WCAP-8692) FUEL ROD BOWING. Reavis, J. R.; Leech, W. J.; Cadek, F. F.; Cerni, S.; Hellman, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa (USA)). Dec 1975. 130p. Westinghouse Electric Corp., Pittsburgh, PA.

The purpose of this investigation was to quantify the extent of fuel rod bowing in Westinghouse pressurized water reactors and to assess the effects of fuel rod bowing on plant safety and reliability. An empirical bow correlation was developed based on data from irradiated assemblies. Analyses conducted with these conservative empirical predictions show that: (1) generically identified DNBR margins are adequate to offset DNBR reductions due to rod bow, (2) the present design practice of increasing the highest calculated core peaking factor is sufficient to account for all deviations, including the effects of rod bow, and (3) fretting and corrosion of bowed rods are negligible. These conclusions indicate that fuel rod bowing results in no impact on plant safety or reliability. (auth)

25268 EPRI PROGRAM IN WATER REACTOR SAFETY. Loewenstein, W. B.; Gelhaus, F.; Gopalakrishnan, A. (Electric Power Research Inst., Palo Alto, CA). Proc. Am. Power Conf.; 37: 129-136(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The basis for EPRI's water reactor safety program is twofold. First is compilation and development of fundamental background data necessary for quantified light-water reactor (LWR) safety assurance appraisals. Second is development of realistic and experimentally bench-marked analytical procedures. The results are expected either to confirm the safety margins in current operating parameters, and to identify overly conservative controls, or, in some cases, to provide a basis for improvements to further minimize uncertainties in expected performance. Achievement of these objectives requires the synthesis of related current and projected experimental-analytical projects toward establishment of an experimentally-based analysis for the assurance of safety for LWRs. (auth)

25269 REPORT ON STUDY OF ATOMIC INDUSTRIAL FORUM ON POWER PLANT SITING. Heilman, W. L. (Commonwealth Associates Inc., Jackson, MI). Proc. Am. Power Conf.; 37: 164-169(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Perhaps the most significant result to be drawn from the study described is that there is, indeed, a common site-selection framework within the utility industry. While the individual components within this framework may vary considerably, the integrity of the process as a whole is sound. With this knowledge in hand, it is hoped that a unified approach to reporting site-selection activities can be developed and that an associated speedup of the licensing process can be accomplished. It must be recognized, however, that nuclear power plant site selection and evaluation is an evolving process involving a relatively new source of energy for power generation. Accordingly, the need for continued study and updating of these techniques is considered desirable as industry and government strive to achieve a common goal of acceptable and timely sites for nuclear power plants. (auth)

25270 DECONTAMINATION OF DRESDEN UNIT 1. Kiedaisch, W. I. (Commonwealth Edison Co., Chicago). Proc. Am. Power Conf.; 37: 267-270(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Chemical cleaning of cooling system surfaces is proposed for Dresden-1 in order to remove radioactive deposits which contribute to increased radiation doses to station personnel. (DG)

25271 OVERVIEW OF REACTOR SAFETY STUDY WASH-1400. Levine, P. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Rev. Energ.; 26: No. 274, 699-725(Jun 1975). (In French, English)

A detailed description of the methodology which was developed to estimate the accident risks in light water nuclear power plants is given. The event tree method was used. A set of event trees was established in order to define the accident sequences, these trees are discussed at several levels of detail to illustrate their development and use. Sets of accident sequences and their probabilities of occurrence were identified and complementary analyses were performed to calculate the distribution of radioactivity in the environment for each set of accident sequences. (FR)

25272 THE COASTLINE SITE POSSIBILITIES FOR NUCLEAR POWER PLANTS. Lebreton, J. C. (Electricite de France, 75 - Paris. Dept. Etudes Generales Programmes-Sites Environnement). pp 1-12, pt.BxCa116 of 2nd International Colloquium on the Exploitation of Oceans. Vol. 5. Oceanic Development Policies. Confrontation Sessions. Paris, France; Association pour l'Organisation de Colloques Oceanologiques a Bordeaux ([nd]). (In French)

From 2nd international colloquium on the exploitation of oceans; Bordeaux, France (1 Oct 1974).

Following a survey of the total energy needs in France, the territorial possibilities for nuclear power plant sites, the intrinsic qualities of the coastline from the cooling point of view and the physical, biological and socioeconomic effects of nuclear stations on the coast are examined. (FR)

25273 RADIATION SAFETY DURING ATOMIC POWER STATION OPERATION. Burnazyan, A. I. At. Energ. (USSR); 39: No. 3, 167-172(Sep 1975). (In Russian)

The results of many years of scientific investigations and radiation monitoring at Soviet atomic power stations are summarized. It is shown that in areas to which personnel have free access the radiation level is quite satisfactory and working conditions do not differ from those at non-atomic industrial enterprises. In areas to which personnel have strictly limited access, radiation levels do not exceed established permissible values and at atomic power stations based on VVER-440 water-moderated water-cooled reactors the levels are considerably below these values. During ten years of atomic power station operation not a single case of radiation sickness, or even functional deviation from the norm in the organism of personnel has occurred. Discharges of radioactive matter into the atmosphere and open waters are considerably below permissible levels, practically do not affect the radiation level of the environment, and are absolutely harmless to the population living in the vicinity of atomic power stations. (auth)

25274 COMPARISON OF THE RADIATION SAFETY OF FISSION AND FUSION REACTORS. Sivintsev, Yu. V. At. Energ. (USSR); 39: No. 3, 173-176(Sep 1975). (In Russian)

A critical analysis of the work of Haefele and Starr regarding the relative radiation safety of fission and fusion nuclear reactors is given. A number of comments in the framework of the conventional approach are made, and an extensive system analysis of the problem is proposed. (auth)

25275 COMPOSITIONAL CHANGES OF MOLTEN STAINLESS STEEL PENETRATED IN UO_2 IN FUEL RODS TESTED TO FAILURE. Hornsveld, E. M.; Schoots, T. (Stichting Reactor Centrum Nederland, Petten). J. Nucl. Mater.; 58: No. 2, 227-232(Nov 1975).

As part of an experimental program on Fast Reactor Safety fuel pins specified for the core of SNR-300 at Kalkar are being tested to failure. The test capsules are irradiated in the Poolside Facility of the 45 MW High Flux Reactor at Petten at a linear power of approximately 550 W/cm. A sudden interruption of the heat flow simulates a loss of coolant flow condition in an LMFBR. The experiment is terminated by scramming the reactor. The failure modes after various delay times are analyzed. With a delay time of about 15 sec melting of large parts of the fuel and the stainless steel canning takes place. The failed pins are examined by metallography and microanalysis. In the case of the test LOC 08 with a delay time of 16.1 sec before the reactor scram, molten canning material had penetrated into the fuel. The resulting changes in the composition of this canning material are described. (NL)

25276 RASIN: RISK ANALYSIS OF THE FISSILE MATERIAL CYCLE IN THE NETHERLANDS. Ingenieur (The Hague); 87: No. 44, 869-875(30 Oct 1975). (In Dutch).

A complete fissile material cycle for 3500 MW(e) of installed nuclear power is illustrated; this is associated with extraction and waste replacement of about 325,000 tons of uranium ore, 123 tons of uranium as dioxide, 3.3 tons of fission products and radioactive transfers to earth and water. The term "risk" is defined as the product "chance" multiplied by "effect". Individual risks analyzed include potential pollution to coolant water, ground contamination, pickup from grassland, vegetable and fruit, accumulation on buildings, absorption by rainwater and transmission to drinking water, etc. Specific reactor studies relate to Dodewaard and Borssele, and a national study for a 1000 MW(e) plant averaged over five potential sites. Probability studies are related to natural hazards such as the impact of meteorites. (NL)

25277 MATERIALS AND METHODS OF EFFLUENT CONTROL USED AT ELECTRICITE DE FRANCE. Martin, J. J. (Electricite de France, 93-Saint-Denis. Dept. de Radioprotection). pp 177-179 of Proceedings of the Seminar on the Monitoring of Radioactive Effluents. Seminar Organized by the OECD Nuclear

Energy Agency in Collaboration with the German Ministry for Research and Technology and the Karlsruhe Nuclear Research Centre, Karlsruhe, 14-17 May 1974. Paris, France; Organization for Economic Co-operation and Development. Publications Office (1974). (In French)

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

The testing of gaseous and liquid effluents under the responsibility of the nuclear power station operator and the quality check provided by the Radioprotection Department of Electricity of France are described. (INIS)

25278 ATMOSPHERIC COOLING OF NUCLEAR POWER STATIONS. Mayor, J. C. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 466-469(Nov 1974). (In French)

Feasibility studies relevant to HTGR, HHT, BWR and PWR types of nuclear reactor of about 900 MW(e) capacity are presented. Detailed consideration is given to wet and dry cooling towers, and to economic aspects and micro-climate formation. A comparison of the principal variables to be taken into consideration in cooling tower design is shown in tabular form, and includes safety and environmental factors. (INIS)

25279 NUCLEAR POWER DEVELOPMENT AND ITS EFFECT ON LIVING ENVIRONMENT. Zaduban, M. pp 181-208 of Living Environment and Our Civilization. Bratislava; ALFA (1972). (In Slovak)

The development of nuclear power in the world to 2000 is outlined, particular attention being devoted to CMEA countries, mainly to Czechoslovakia. Principal effects of nuclear power on the living environment are briefly discussed. (INIS)

25280 SITE SEEING. Sherlock, P.; Rospenda, R. E. Nucl. Act.; No. 13, 30-34(Jul 1975).

The many factors to be considered for nuclear power plant site selection can broadly be categorized as site development and environmental factors. Generally, site development factors are objective criteria and lend themselves to economic analysis. The environmental factors are more subjective in nature and often are not readily quantifiable. To analyze these factors, a multi-disciplinary group of professionals is used and a systems analysis approach for gathering and analyzing the data and making recommendations and decisions is employed. Ideally, the siting studies should consider a large region or, for the USA, the full service area of the utility. Some of the site development factors that have to be taken into account comprise the proposed generating station, the water supply, methods of waste heat dissipation, the size of the area, land acquisition and topography, geology, seismology, also transmission development, access and transportation. Environmental factors include water quality, population, land use, meteorology, public safety, terrestrial ecology, aquatic ecology, socio-enconomics and aesthetics. Although public safety is but one of the environmental factors, in a sense it encompasses all the other factors and may be considered as the single most important criterion. It is related to the basic integrity of the nuclear plant itself and the radioactive releases to the environment. (auth)

Reactor Theory and Calculation

Refer also to abstracts 24638 and 24652.

25281 (NUREG-75/099) EVALUATION OF FISSION PRODUCT AFTER-HEAT. Annual Report, May 1, 1974-June 30, 1975. Spinard, B. I. (Oregon State Univ., Corvallis (USA). Dept. of Nuclear Engineering). 1975. 114p. NTIS $5.50.

Studies are described which were undertaken to develop and justify a method for predicting, according to an appropriate graph, formula, or algorithm, the power generated by fission products after a sudden shutdown of a power reactor as a function of time after shut down. Included are sections on fission yield data and errors, preparatory studies, and calculation of decay power. (DG)

25282 (ORNL/TM-5239) USE OF VARIATIONAL TECHNIQUES FOR THE ESTIMATION OF NEUTRON DETECTION EFFICIENCY. Lin, S.; Robinson, J. C.; Flanagan, G. F. (Oak Ridge National Lab., Tenn. (USA)). Feb 1976. Contract W-7405-eng-26. 99p. Dep. NTIS $6.50.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The neutron detection efficiency is a parameter required in the measurement of reactivity by the modified source technique. The direct solution of the detection efficiency at a perturbed state is costly. To solve for this, a particular variational functional, the Lewins' type variational functional, is presented. The functional is a ratio of two other functionals, each dealing with a reaction rate. The evaluation of this particular functional was done by treating the numerator and the denominator functionals separately. This leads to three flux equations, one for forward flux, and two for adjoint fluxes. The advantages of this formulation over, and the equivalence of this formulation to, the conventional functional presented in the literature are described in detail. The flexibility of the proposed functional is demonstrated by using it to estimate the detection efficiency with four different methods: variational interpolation, conventional variational, variational extrapolation, and multi-reference-state variational. Results are presented for one-dimensional and two-dimensional problems. All results are compared with direct calculations. In all cases, the results show that the variational interpolational method and the multi-reference-state variational method are efficient and practically acceptable.

25283 (RD/B/N-3352) ATTENUATION OF TEMPERATURE OSCILLATIONS IN PASSING THROUGH LIQUID METAL BOUNDARY LAYERS. Lawn, C. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1975. 42p. (CFR/THWG/P-(75)106). Dep. NTIS (US Sales Only) $4.00.

One aspect of predicting the endurance of components subject to thermal fatigue in liquid metal cooled reactors is the extent to which oscillations in fluid temperature are transmitted to metal surfaces, such as the above-core structure. The first geometry considered is that of a solid plate in contact with a layer of stagnant fluid, in which temperature oscillations are imposed at a given distance from the plate. The rear face of the plate is taken to be adiabatic and results are presented for the amplitude of temperature oscillations on the front face. These are in a general form, applicable to all fluids and solids. A criterion is derived from the results for conditions under which it is valid to calculate the surface response while assuming the plate to be isothermal through its thickness, (the "infinite conductivity" approximation). Transmission through laminar boundary layer developing over the plate surface is then considered. An approximate calculation based on the slug-flow analysis of Sucec (1975) is developed. This includes the effect of a thin hydrodynamic boundary layer in which convection is ignored and it is shown to provide reasonably accurate results for liquid metals. The degree of attenuation of temperature oscillations predicted by this model with the "infinite conductivity" approximation is presented as a function of frequency, plate thickness development distance, and fluid velocity, for a sodium/stainless steel interface. The possible effect of turbulence upon the results is discussed. (auth)

25284 (RT/FIMA-(75)2) ASYMPTOTICALLY STABLE SOLUTIONS OF FUNCTIONAL DIFFERENTIAL EQUATIONS IN NODAL REACTOR DYNAMICS. Baran, W.; Trombetti, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1975. 37p. Dep. NTIS (US Sales Only) $4.00.

The influence exerted on the stability of an equilibrium state of a second order differential-difference system by the delays existing in the coupling terms of the two system equations is discussed. On certain hypotheses an asymptotic stability condition is determined which is independent of the magnitude of delays but dependent on the magnitude of coupling. A simple method for constructing regions belonging to the domain of attraction of the considered equilibrium state is developed. Several alternative constructions and applications to the two-node nuclear reactor kinetics model are discussed in detail. (auth)

25285 STARTUP OPERATION OF BROWNS FERRY'S 1152-MW NUCLEAR UNITS. Calhoun, J. R. (Tennessee Valley Authority, Chattanooga); Green, H. J.; Beers, R. B. Proc. Am. Power Conf.; 37: 90-95(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

An overview is presented of startup operation for the Browns Ferry-1 reactor, and comparisons are made with the startup of Browns Ferry-2. Included are comments on the selection of the BWR type steam supply system, reactor fueling, problems encountered, and plant availability. (DG)

25286 RELATION BETWEEN NONLINEAR OF "NOT-LINEAR" CHARACTERISTICS IN NUCLEAR KINETICS AND NOISE ANALYSIS OF NEUTRON FLUX. Kataoka, H. Ann. Nucl. Energy; 2: No. 2-5, 407-413(Jun 1975).

From European-American committee on reactor physics specialist meeting on reactor noise: from critical assemblies to power reactors; Rome, Italy (21 Oct 1974).

The "not-linear" or "2nd-class-nonlinear" characteristics in nuclear reactor kinetics combine with the feedback effect in the high-power operation and induce the increase in the amplitude of the neutron-flux noise, especially in the very low frequency region. The fundamental behavior of "not-linear" characteristics and its effect for reactor noise was investigated. Application of

the reactor noise analysis technique to power reactors has not been successful because of unexplained large disagreement between the result of the conventional theoretical analysis and the experimental facts. When the cause of this discrepancy is clear, reactor noise analysis techniques can be effectively applied to instrumentation, control, monitoring, and diagnosis of power reactors. (auth)

25287 INVESTIGATIONS OF THE INFLUENCE OF FEEDBACK AND COUPLING EFFECTS ON NEUTRON NOISE IN A NUCLEAR REACTOR. Vath, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe, Ger.). Ann. Nucl. Energy; 2: No. 2-5, 427-435(Jun 1975).

From European-American committee on reactor physics specialist meeting on reactor noise: from critical assemblies to power reactors; Rome, Italy (21 Oct 1974).

Investigations are described of the influence of a known feedback, i.e., a control loop with known transfer function, on the spectra of neutron chamber signals. Theoretical formulas for the spectra are derived using the point reactor model. These formulas were verified by noise measurements in a zero power reactor. Special attention is given to the noise generated by the control loop, the influence of this feedback noise on the spectra being verified experimentally. In large reactors space dependent transfer functions must be taken into account. As a first approximation to handle the spatial dependence, the afore-mentioned investigations were extended to the two-point reactor model. Corresponding experimental work was done for the Argonaut Reactor Karlsruhe (ARK) with a symmetrical two-slab core loading. Coolant boiling in a BWR was investigated. The boiling must be considered as a feedback mechanism as well as an external reactivity perturbation. In order to simulate the steam bubble content, nitrogen gas was injected into the water moderator of the ARK. By modulating the total gas flow according to the instantaneous reactor power the feedback effect was simulated. The gas flow produced a band-limited white reactivity noise. The upper break frequency could be used to determine the travelling time of the bubbles through the core. (auth)

25288 FISSION DRIVEN ACOUSTIC WAVES IN A URANIUM GAS CORE REACTOR. Scudder, J. D. College Park, MD; Univ. of Maryland (1975). 187p. University Microfilms Order No. 75-28,771.

Thesis (Ph. D.).

The stability of plasma was investigated in a finite geometry gas core fission reactor. A model (light bulb style) gas core reactor, in the slab approximation, with isothermal walls, has been found (analytically and numerically) to be linearly stable against the growth of fission-driven sound waves for a variety of equilibria. For weak gradient equilibria it has been analytically shown that the shortest unstable wavelength, lambda/sub crit/, is unable to fit into the reactor dictated by the physical reactor parameters which determined lambda/sub crit/. However, it has been (numerically) shown for weak and strong gradient equilibria that nonlinear mode growth via mode pumping can occur for as long as 10 to 15 sound transit times after the perturbation is introduced; beyond 40 sound transit times all mode amplitudes decay and the system asymptotically relaxes to its original unperturbed state. Steady state equilibria for slab and spherical 1-dimensional geometries have been determined and the core temperature-reactor size relationship derived under suitable assumptions. The family of steady state solutions for the slab and sphere have also been investigated. It has been established for a given core temperature and reactor pressure that there are upper limits on the size of OMEGA, (OMEGA is the ratio of fission power deposition to radiation dissipation on the steady state). The core temperature size relationship indicates that the equilibrium gas core size is proportional to OMEGA; the upper bounds on OMEGA imply upper bounds for the reactor size which have played an important role in the understanding of linear stability of these modeled reactors against fission driven oscillations. (Diss. Abstr. Int., B)

25289 EXACT SOLUTION OF P_1 TIME-DEPENDENT EQUATIONS WITH TIME-DEPENDENT CROSS SECTIONS FOR 2D AND 3D GEOMETRY. Lemanska, M. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center); Mennig, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Z. Angew. Math. Phys.; 25: No. 6, 735-741(25 Nov 1974).

Exact, analytic solutions of the monoenergetic, time-dependent P_1 equations with time-dependent cross sections are given for 2D and 3D slab geometry. (auth)

25290 OPERATIONAL DIAGNOSTICS OF POWER REACTORS. Dach, K.; Pecinka, L. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). Jad. Energ.; 20: No. 12, 397-403(Dec 1974). (In Czech)

The concept is proposed of a new scientific discipline, the operational diagnostics of power reactors. An analysis is presented of the possible sources of disturbances in power reactors in stationary operating regime and ways are suggested for their detection, the evaluation of measured values, the analysis of measurement results, the localization of the sources of disturbances and the determination of the degree of risk. (INIS)

25291 HEAT TRANSFER. Markoc y, G. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 429-432(Nov 1974). (In German)

Heat transfer studies in the EIR are detailed, and include a list of eleven reactor types studied, including CO_2 and steam cooled, boiling water, helium cooled, heavy water and sodium cooled reactor systems. A test loop bundle AGATHE-HEX is illustrated; this is a 1000 kW loop with 37 electrical heaters, and has been used in a number of studies. Two phase studies are in progress using a freon-water system for model purposes. The article concludes with a mention of a joint study on sodium cooled fast reactors with the Atomics International organization. (INIS)

Reactor Components and Accessories

Refer also to abstracts 23354, 23807, and 23810.

25292 (AECL-5242) STEAM GENERATOR TUBE FAILURES: WORLD EXPERIENCE IN WATER-COOLED NUCLEAR POWER REACTORS IN 1974. Hare, M. G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1975. 18p. Dep. NTIS (US Sales Only) $3.50.

Steam generator tube failures were reported at 25 out of 59 water-cooled nuclear power reactors surveyed in 1974 compared to 11 out of 49 in 1973. This report summarizes these failures, most of which, where the cause is known, were due to corrosion. Water chemistry control, inspection and repair procedures, and failure rates are discussed. (auth)

25293 SEISMIC DESIGN CONSIDERATIONS FOR A STANDARD NUCLEAR POWER PLANT. Setlur, A. V. (Fluor Pioneer Inc., Chicago). Proc. Am. Power Conf.; 37: 137-145 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The major parameters affecting the seismic response of nuclear power plant structures are highlighted. Results of a soil-structure interaction study as well as problems associated with the foundation design criteria for a standard plant are discussed. The impact of the enveloping broadband floor spectra on the seismic qualifications of equipment and piping is presented. (auth)

25294 APPROACH TO THE DESIGN OF NUCLEAR POWER PLANTS FOR HIGH EARTHQUAKE GROUND MOTION. Reeves, C. F.; Miczek, C. B. (Stone and Webster, Boston). Proc. Am. Power Conf.; 37: 146-156(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

A structural concept is presented for reinforced-concrete nuclear power plant containment structures at sites where earthquake ground motion in terms of the Safe Shutdown Earthquake (SSE) exceeds 0.3 g. The structural layout is suitable for all light-water and gas-cooled reactor systems currently available in the United States. Preliminary structural layouts for each of the reactor systems have been completed and analyzed for SSE ground motions equal to 0.5 g for an actual site. Since the results of the seismic analyses are similar for all of these designs, structural schematics and seismic responses for only one of the reactor systems are shown, viz., the pressurized-water reactor (PWR). The analytical techniques employed and the basic considerations of structure and equipment design for high earthquake motions are discussed. Recommendations are made concerning the integration of the nuclear steam supply systems and containment structures for sites where high seismic loading is a major design consideration. (auth)

25295 DESIGN CAPABILITY OF NUCLEAR POWER PLANTS TO WITHSTAND COMBINATIONS OF NATURAL AND MAN-MADE HAZARDS. Gilbert, W. D. (General Electric Co., San Jose, CA). Proc. Am. Power Conf.; 37: 157-163(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

The following topics are discussed: (1) the design considerations for a standardized plant as reflected in the General Electric Standard Safety Analysis Report (GESSAR); (2) a comparison of the site parameters as specified in GESSAR with those recently

suggested by the Nuclear Regulatory Commission; and (3) the pioneering efforts being undertaken by the American Nuclear Society to utilize the probability of simultaneous occurrence of events as a means to select event combinations in establishing plant design requirements. (auth)

25296 REPORT ON THE ACTIVITIES OF THE ASME RESEARCH COMMITTEE ON WATER IN THERMAL POWER SYSTEMS. Noll, D. E. (Calgon Corp., Pittsburgh). Proc. Am. Power Conf.; 37: 750-752 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

In the Research Committee's report presented during the American Power Conference in 1974, the alignment into three subcommittees—Utility, Industrial Boiler, and Aqueous Discharge—was described. The decision to abandon a relatively large number of subcommittees of limited scope in favor of three of wide and timely interest has proven to be a wise one. Consequently, the Research Committee has made accelerated progress toward the achievement of its mandate of seeking out areas where research is needed. A review of the activities of each of the Subcommittees is presented. (auth)

25297 MACHINES. Chapter 13. Hug, Michel (Electricite de France, 75 – Paris. Direction de L'equipement). pp 595-564 of Fluid Mechanics Applied to Equipment and Energy Problems. Hug, M. (ed.). Paris, France; Eyrolles (1975). (In French) (Electricite de France, 75 – Paris. Direction des Etudes et Recherches).

Three different approaches of the basic concepts involved in designing and operating hydraulic machines are presented. The essential general data, characteristic graphs, and similitude are described. An analysis using logical charts is presented in seven tables: turbomachines, flow and pressure regulation, construction, mechanical performance, stress resistance, use and economic aspects. These charts are illustrated with selected examples such as the ejectors of a BWR and Bugey blowers. (FR)

25298 PIPE PENETRATION STRUCTURE FOR A NUCLEAR REACTOR. Swart, W. (to De Rotterdamsch Droogdok Maatschappij B. V.). US Patent 3,907,636. 23 Sep 1975. Filed date 15 Nov 1972. 6p.

A design is described for a pipe penetration structure for the wall of a nuclear reactor vessel, such as the cover thereof, including a hole in the wall, having a stepped part as a transition between a narrower bore and a wider bore and a bushing, extending through the hole, the bushing being connected to the interior of the hole in the narrower bore part of the hole, and being double-walled in the wider bore part of the hole, the two walls of the bushing in the wider part being connected outside the vessel wall by a thin and curved transition wall forming a flexible joint, and the outer wall of the double-walled part of the bushing being welded to the vessel wall. (Official Gazette)

25299 SUPPLIERS OF HIGH QUALITY PRODUCTS AND SERVICES. Feuz, P. Nucl. Eng. Int.; 20: No. 231, 573-574 (Jun 1975).

The achievements of Swiss companies in supplying equipment for nuclear power plants throughout the world are briefly described. (UK)

25300 NUCLEAR POWER PLANT CONTAINMENT CONSTRUCTION. Schabert, H. P.; Danisch, R.; Strickroth, E. (to Siemens Aktiengesellschaft). US Patent 3,929,568. 30 Dec 1975. Priority date 11 Sep 1972, German, Federal Republic of (F.R. Germany). 8p.

The Nuclear Power Plant Containment Construction includes the spherical steel safety enclosure for the reactor and the equipment associated with the reactor and requiring this type of enclosure. This steel enclosure is externally structurally protected against accident by a concrete construction providing a foundation for the steel enclosure and having a cylindrical wall and a hemispherical dome, these parts being dimensioned to form an annular space surrounding the spherical steel enclosure, the latter and the concrete construction heretofore being concentrically arranged with respect to each other. In the disclosed construction the two parts are arranged with their vertical axis horizontally offset from each other so that opposite to the offsetting direction of the concrete construction a relatively large space is formed in the now asymmetrical annular space in which reactor auxiliary equipment not requiring enclosure by the steel containment vessel or safety enclosure, may be located outside of the steel containment vessel and inside of the concrete construction where it is structurally protected by the latter.

Reactor Fuels

Refer also to abstract 23677.

25301 (AECL-5104) IN-REACTOR THERMAL CONDUCTIVITY OF U–Si–Al. Fehrenbach, P. J.; Cotnam, K. D.; Morel, P. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1975. 44p. Dep. NTIS (US Sales Only) $4.00. AECL $1.00.

A solid U–Si–Al element clad in cold-worked Zr–2.5 wt percent Nb and containing four internal thermocouples was irradiated to a burnup of about 50 MWh/kg U at a linear power of 55 kW/m (182 MeV/fission). The central fuel temperature at full power decreases continuously from 817 K just after the initial startup to 782 K after a burnup of 50 MWh/kg U. The thermal conductivity determined from data obtained from the initial reactor startup fit the relation lambda (T) equals $0.0108 + 2.52 \times 10^{-5}$ (T-273) $kWm^{-1}K^{-1}$. This agrees to within 5 percent of data obtained independently from out-reactor tests. Irradiation caused a small decrease in conductivity at temperatures below 675 K and a corresponding slight increase in the temperature sensitivity. At a burnup of 40 MWh/kg U the in-reactor data fit the relation lambda (T) equals $0.00776 + 3.32 \times 10^{-5}$ (T-273) $kWm^{-1}K^{-1}$. Both of these relations result in a thermal conductivity 10 percent to 20 percent lower than that for U_3Si. The observed decrease in operating fuel temperature is consistent with an increase in fuel/sheath heat transfer coefficients with burnup, which has been postulated for uranium silicide fuel elements. Heat transfer coefficients calculated from data obtained in this experiment ranged from 25 $kWm^{-2}K^{-1}$ for fresh fuel to 160 $kWm^{-2}K^{-1}$ after a burnup of 40 MWh/kg U.

25302 DEVELOPMENT OF COMMONWEALTH EDISON COMPANY'S NUCLEAR FUEL DATA BANK. Casey, S. R.; Klein, W. A.; Koncel, E. F. Jr. (Commonwealth Edison Co., Chicago). Proc. Am. Power Conf.; 37: 173-177 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

A discussion is presented of the phases in the Nuclear Fuel Data Bank's development, its features, and plans for future applications and expansions. (auth)

25303 METHOD AND APPARATUS FOR DETECTING MALASSEMBLED NUCLEAR FUEL RODS. Akey, J. G.; Wachter, W. J. US Patent 3,901,090. 26 Aug 1975. Filed date 15 Feb 1972. 10p.

A fuel bundle having fuel rods supported by a plurality of grids with supporting fingers arranged at two axes of support is vibrated over a predetermined frequency range with in-phase and out-of-phase shakers while establishing signal representations of various rod resonant frequencies and magnitudes at particular frequency modes as well as bundle fundamental frequencies and harmonics thereof. A comparison of the rod resonant frequency responses along one of the axes provides a method of determining that a loose rod exists along a particular grid line. The characteristic detected is the relatively low amplitude of the rod resonance response at that line of grid detection as compared to the response, along the same axis, of the responses detected along the same parallel axis of the two adjacent grids. The particular defective support location within the grid may then be determined by performing a similar test along the other axis so that the intersection of the two points of abnormal vibration response will locate the defective point. In addition to providing an accurate and precise method of determining a loose rod, the invention also permits development of a total bundle "signature" characteristic which may be compared to the known "signature" of a good bundle to determine the adequacy of the total assembly. In the specific method of testing and defect location, provision is made to provide for seismic response testing along with those tests designed to locate a loose rod, or an abnormal bundle characteristic. In addition, provision is also made to detect the occurrence of "extra" frequencies as an added insurance that no defect or loose particles or pieces will go undetected and, further, to detect the occurrence of an impact (pinging) which may occur from a loose rod. (Official Gazette)

25304 METHOD OF MAKING FUEL AND FERTILE ELEMENTS FOR NUCLEAR-REACTOR CORES. Gyarmati, E.; Nickel, H. (to Kernforschungsanlage, Juelich, Ger.). US Patent 3,907,948. 23 Sep 1975. Priority date 27 Jun 1969, German, Federal Republic of (F.R. Germany). 6p.

A method of making fissionable-fuel or fertile elements for the core of a nuclear reactor, especially a reactor of the gas-cooled type, is described. The fuel or fertile material is introduced into graphite shells in the form of coated particles and a pyrolytically decomposable carbon-containing or silane gas is passed upwardly through the shell while the mass therein is heated by displacing an induction-furnace core downwardly around the graphite shell thereby bonding the coated particles together with pyrolytic carbon, silicon carbide or zirconium carbide formed in situ to yield a coherent mass with a porosity of, say, 10 to 25 percent. The gas is preferably a mixture of one or more inert gases (nitrogen, argon or helium) with one or more hydrocarbons or carbon-

containing gases, e.g., methane, acetylene, benzene, or silanes. (Official Gazette)

25305 NUCLEAR FUEL ELEMENT AND A METHOD OF MANUFACTURE THEREOF. Wood, J. C. (to Canadian Patents and Development Ltd.). US Patent 3,901,761. 26 Aug 1975. Priority date 1 Dec 1972, Canada. 6p.

A nuclear fuel element having a sheath of zirconium or a zirconium alloy and a cross-linked siloxane lacquer coating on the inner surface of the sheath and separating the nuclear fuel material from the sheath is described. The siloxane lacquer coating retards cracking of the sheath by iodine vapor emitted by the fuel during burn-up, and acts as a lubricant for the fuel to prevent rupture of the sheath by thermal ratchetting of the fuel against the sheath and caused by differential thermal expansion between the fuel and the sheath. A silicone grease is applied as a thin layer in the sheath and then baked so that oxidative cleavage of the side chains of the grease occurs to form a cross-linked siloxane lacquer coating bonded to the sheath. (Official Gazette)

25306 FUEL ROD PELLET LOADING HEAD. Howell, T. E. (to Exxon Nuclear Co., Inc.). US Patent 3,907,123. 23 Sep 1975. Filed date 31 May 1973. 6p.

An assembly for loading nuclear fuel pellets into a fuel rod comprising a loading head for feeding pellets into the open end of the rod is described. The pellets rest in a perforated substantially V-shaped seat through which air may be drawn for removal of chips and dust. The rod is held in place in an adjustable notched locator which permits alignment with the pellets. (Official Gazette)

25307 PLATE SPRING OR RETAINING GRID FOR A BUNCH CYLINDRICAL ELEMENTS ENGAGED IN A HEAT EXCHANGE PROCESS. Piepers, G. G.; Hendrik, L. (to Reactor Centrum Nederland). US Patent 3,929,569. 30 Dec 1975. Priority date 10 Jul 1972, German, Federal Republic of (F.R. Germany). 4p.

A description is given of a grid for the retaining or laterally supporting of primarily nuclear fuel rods, comprising plate springs that exert a retaining force remaining constant, irrespective of the degree of compression. A spring may be spotwelded to the grid, snapped into place in a hole in the grid wall, or both.

25308 DEVELOPMENT OF CARBIDE FUEL FOR FAST REACTORS. Stratton, R.; Bischoff, K. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Neue Tech.; 16: No. 11, 432-438(Nov 1974).

In 1967/68 as part of its long term study on Fast Reactors the Federal Institute decided to study, on a small scale, a ceramic material which it was felt had a good potential as a future high performance fuel. This was a mixed carbide consisting of a solid solution of uranium (~81%) and plutonium (~14%) chemically bound with carbon (~5%). The program consists of a study of fuel manufacture, its performance testing under irradiation, followed by breakdown to study the irradiation induced changes. A unique aspect of the fuel manufacturing studies was the choice of the production route—a sol-gel method whereby the fuel is produced by a purely chemical process and formed directly into spheres of ~60 and 800 μdia. This fuel can be filled into the standard type of pin (many pins forming a cluster of fuel element). The method has a number of advantages over the traditional cylindrical pellet fuel production route. (auth)

25309 FISSION ENHANCED CREEP IN CERAMIC NUCLEAR FUELS. A Method for the Interpretation of Experimental Results Obtained from In-Pile Measurements. Caridi, A.; De Vita, F.; Merlini, C. (Politecnico di Torino (Italy)); Zeisser, P. (Stichting Reactor Centrum Nederland, Petten). Energ. Nucl. (Milan); 21: No. 5, 267-275(1974).

A method is described to define, in the case of an in-pile experiment, the equivalent values of the parameters—fission rate, stress and temperature—which affect the fission creep, and would cause the same creep rate in the case of a homogeneous parameter distribution. This method includes the determination of the parameter distribution and the postulation of a relationship between the parameters and the creep rate. The method is applied to an experiment in the High Flux Reactor at Petten, using a stack of UN specimens at fission rate up to 10^{14} cm^{-3} s^{-1}, stresses up to 70 MNm^{-2} and temperatures up to 1100°C. (INIS)

Reactor Control Systems

25310 (HEDL-TME-75-131) USER'S MANUAL FOR CONROD: A COMPUTER PROGRAM FOR THE DESIGN ANALYSIS OF LMFBR CONTROL ELEMENTS. Birney, K. R.; Pitner, A. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1975. Contract E(45-1)-2170. 48p. AT.

The CONROD computer program is a conservative performance analysis code for LMFBR control rod assemblies. It performs calculations for thermal performance, boron carbide gas release, swelling, cladding stress and strain, coolant flow split, pressure drop, and reactivity worth depletion as a function of operating time. While it was developed along with the design of the FFTF control elements, it can be applied to other LMFBR designs by appropriate changes in data statements and geometrical correlations.

25311 A FINE-CONTROL AND SAFETY MECHANISM FOR FAST REACTORS. Delemontey, R. (to Groupement pour les Activites Atomiques et Avancees (GAAA), 92 – Le Plessis-Robinson (France)). French Patent 2,232,819/E/. 8 Jun 1973. 5p. (In French)

Improvements are described, according to which the means for suspending the absorbing element is preferably a so-called calibrated chain. The coupling means can be an electro-magnet, the conductive wire of which is coated with a magnesia layer outwardly protected by a sheath of refractory material. This can be applied to the manufacture of small-sized fine-control and safety mechanisms for fast reactors. (FR)

25312 ADVANCED CONTROL CENTER DESIGN FOR NUCLEAR POWER PLANTS. Myers, J. E. Jr.; Veirs, J. W. Jr. (Combustion Engineering, Inc., Windsor, CT). Proc. Am. Power Conf.; 37: 993-1005(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Included are comments on design objectives, integrated design approach, advanced control center design, data processing systems, supporting control and instrumentation systems, and design analysis. (DG)

Nuclear Power Plant Economics

Refer also to abstract 23258.

25313 EVOLVING INCENTIVES AND TECHNICAL PROGRAMS FOR ATTAINING HIGHER PLANT PRODUCTIVITIES. Zebroski, E. L.; Lapides, M. E. (Electric Power Research Inst., Palo Alto, CA). Proc. Am. Power Conf.; 37: 178-193 (1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Included are discussions on quantifying fuel conservation and cost incentives for increasing nuclear plant productivity, value of improvements in technology, possible avenues of plant productivity increases, causes of plant outage, failure mode analysis, quality assurance levels for components and materials, and cost/benefit analysis of improvement programs. (DG)

25314 SWITZERLAND AND NUCLEAR ENERGY IN THE YEAR 1973. Schweiz. Bauztg.; 92: No. 44, 1005-1007(31 Oct 1974). (In German)

The important role of nuclear energy in Switzerland is briefly discussed particularly as a result of the energy crisis and the steep increase in world oil prices. The delays encountered as a result of opposition to the siting of nuclear reactors are described. A progress report and technical details are given on each nuclear power station under construction or authorized. Reference is made to the important contribution made by Swiss industry and Swiss design consultants in the field of nuclear power generation. (INIS)

Reactor Fuel Cycle Economics

25315 (IEA-44) UTILIZATION OF THORIUM: CONVERSION RATIO AND FUEL NEEDS IN THERMAL REACTORS. Oosterkamp, W. J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Mar 1975. 11p. (In Portuguese). Dep. NTIS (US Sales Only) $3.50.

As a preparatory study for thorium utilization in thermal reactors a study has been made of the fuel consumption in existing reactor types. A quantitative description is given of the influence of enrichment, burnup, amount of structural material, choice of coolant and control requirements on the conversion ratio. The enrichment is an important factor and a low fuel consumption can be achieved by increasing the enrichment. (auth)

Reactor Licensing and Regulation

25316 (DOCKET-50155-484) BIG ROCK POINT NUCLEAR PLANT. 23rd Semiannual Report of Operations, July–December 1976. (Consumers Power Co., Jackson, Mich. (USA)). 26 Feb 1976. 84p. Dep. NTIS $5.00.

Net electrical power generated was 240,333.9 MWh(e) with the reactor on line 4,316.6 hr. Information is presented concerning

operation, power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational radiation exposure, release of radioactive materials, changes, tests, experiments, and environmental monitoring. (FS)

25317 (DOCKET-50220-510) NINE MILE POINT NUCLEAR STATION, UNIT 1. Annual Report of Operation, 1975. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 25 Feb 1976. 114p. Dep. NTIS $5.50.

Net electrical power generated was 3,044,948 MWh(e) with the reactor on line 6,238 hrs. Information is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational radiation exposure, release of radioactive materials, reportable occurrences, effluent and waste disposal, meteorological summary, and environmental monitoring. (FS)

25318 (DOCKET-50254-713) QUAD-CITIES STATION, UNITS 1 AND 2. Annual Report, 1975. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1976. 122p. (DOCKET-50265-705). Dep. NTIS $5.50.

Net electrical power generated by Unit 1 was 2,246,757 MWh(e) with the generator on line 4,287.5 hrs while Unit 2 generated 1,729,147 MWh(e) with the generator on line 3,056.21 hrs. Information is presented concerning operations, power generation, shutdowns, maintenance, changes, tests, and experiments. (FS)

25319 (DOCKET-50277-613) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Semiannual Operating Report No. 5, July–December 1975. (Philadelphia Electric Co., Pa. (USA)). 1976. 51p. (DOCKET-50278-531). Dep. NTIS $4.50.

Net electrical power generated by Unit 2 was 2,070,655 MWh(e) with the generator on line 3,508 hrs while Unit 3 generated 2,309,418 MWh(e) with the generator on line 4,102 hrs. Information is presented concerning operations, equipment, maintenance, radioactive waste, personnel exposures, organization changes, and training. (FS)

25320 (FIND-50471-S1) FIND: PILGRIM NUCLEAR POWER STATION, UNIT 2. Carter, E. P. (ed.). (Nuclear Regulatory Commission, Washington, D.C. (USA)). Feb 1976. 20p. Dep. NTIS $3.50.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report.

25321 (FIND-STN-50488) FIND: THOMAS L. PERKINS NUCLEAR STATION, UNITS 1, 2, AND 3. Carter, E. P. (ed.). (Nuclear Regulatory Commission, Washington, D.C. (USA)). Feb 1976. 25p. Dep. NTIS $3.50.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report.

25322 (NRCI-75/12) NUCLEAR REGULATORY COMMISSION ISSUANCES, DECEMBER 1975. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1976. 200p. TIC $3.25.

Issuances of the U. S. Nuclear Regulatory Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (JWR)

25323 (NUREG/PRDI-76/1) POWER REACTOR DOCKET INFORMATION. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Jan 1976. 123p. TIC $3.50.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U. S. Nuclear Regulatory Commission in support of applications for construction and operating licenses Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (JWR)

25324 SEISMIC TESTING AND QUALIFICATION OF PROTECTIVE RELAYS. Clark, W. F. (Westinghouse Electric Corp., Newark, DE). Proc. Am. Power Conf.; 37: 1203-1214(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

An attempt was made to evaluate the many parameters of seismic testing for nuclear power plant safety and to apply only the pertinent ones to protective relays. A sine beat input motion effectively duplicates the seismically activated motion of cabinet panels, while limiting cumulative fatigue effects by generating in-phase motion in three axes simultaneously. Further, fragility testing defines the limiting capabilities of a relay, eliminating the need to retest a relay many times as in proof testing. As further experience is acquired in both testing and certification of nuclear systems, the power generation industry will be able to make recommendations for improvements in the seismic testing procedures for protective relays.

25325 NEW APPROACHES IN SEISMIC QUALIFICATION OF CLASS IE METALCLAD SWITCHGEAR. Skreiner, K. M. (General Electric Co., Philadelphia); Fitzgerald, E. M.; Martz, J. W.; Sherlock, J. E. Proc. Am. Power Conf.; 37: 1215-1223(1975).

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975). See CONF-750469-.

Metal-clad switchgear was tested for use in earthquake protection systems for nuclear power plants using biaxial, single- and multiple-frequency excitation. From a large number of tests at high g-levels, future requirements were anticipated to a high degree of probability. Complete documentation is required for qualification; therefore, a large number of test response spectra, time histories, and transmissibility information was recorded. Oscillographic records for all tests monitor electrical continuity and ascertain the absence of spurious operation and unacceptable contact bouncing before, during, and after the tests. Low-level impedance testing was carried out to further study the dynamic characteristics of the equipment. Mechanical impedance modeling was used to analyze the equipment and to predict the seismic response due to a biaxial excitation of 30 seconds duration to an accuracy of within 15 percent in terms of peak amplitude. This mathematical model can be used to predict equipment response due to a three-axis excitation.

25326 NUCLEAR ENERGY: PROGRAM MORATORIUM OR HEARING MORATORIUM. Rev. Energ.; 26: No. 274, 679-682 (Jun 1975). (In French)

After international meetings held at the beginning of 1975 in France and Europe, problems involved in nuclear energy development in France are presented. Arguments provided in favor of a nuclear program moratorium are analyzed and refuted. A hearing moratorium is proposed to provide objective information. (FR)

25327 DEMOCRATIC LICENSING. Nucl. Eng. Int.; 20: No. 231, 575(Jun 1975).

A very brief description is given of the procedures adopted in Switzerland for the licensing on nuclear power stations. The Federal Law on Peaceful Atomic Energy and Protection from Radiation, passed in accordance with the Constitution, places responsibility for licensing on the Confederation and grants the planner of the station a legal right to a building and operating license provided that the statutory requirements are fulfilled. (UK)

25328 JURISDICTION COMPETENCE IN THE SANCTIONING OF NUCLEAR POWER STATIONS IN THE LIGHT OF JUDICIAL PRACTICE. Fischer, U. (Motor-Columbus A. G., Baden (Switzerland)). Bull. Schweiz. Elektrotech. Ver.; 66: No. 5, 269-277 (8 Mar 1975). (In German)

The legal situation in Switzerland is reviewed in the light of government and judicial decisions to date. The federal enactment of August 1973 has clarified the question of competence limits in relation to nuclear security, non-nuclear emissions and landscape preservation. Questions of intercantonal conformity and cooling water use concessions are discussed. (INIS)

GENERAL AND MISCELLANEOUS

Civilian Defense

25329 (AD/A-009226) RECEPTION OF EVACUEES IN DEPOSIT. (New York State Civil Defense Commission, New York (USA)). Mar 1975. 166p. NTIS $6.25.

Report on the Welfare, Warden and Police Operations in Deposit, New York in the EVAC-12 Exercise on May 5, 1957.

The Evac-12 Exercise in Binghamton and Deposit was designed to test a plan for the evacuation of a section of a city and the reception of the evacuees in a prepared town reception area. Detailed plans were drawn up by the staff of the New York Civil Defense Commission for every aspect of the operation and for the many civil defense services that were employed. The people of both Binghamton and Deposit cooperated fully during extensive training periods, a dry-run and the actual exercise on May 5, 1957. Carried out according to plan, the exercise as a whole was a success; the planned procedures worked. Some 1500 evacuees left their homes in the "drainage area" in Binghamton and moved safely and rapidly along 28 miles of highway to Deposit. There they were placed in private homes with fallout cover with a minimum of delay. (GRA)

25330 (ORNL-5039) EXPEDIENT SHELTER CONSTRUCTION AND OCCUPANCY EXPERIMENTS. Kearny, C. H. (Oak Ridge National Lab., Tenn. (USA)). Mar 1976. Contract W-7405-eng-26. 195p. Dep. NTIS $7.75.

This report strongly indicates the practicality of tens of millions of Americans evacuating into rural areas and building and occupying high-protection-factor expedient shelters during an escalating international crisis. This concept was successfully tested by untrained families who built expedient shelters during winter in Colorado, summer in Utah, and spring in Florida. Their efforts are presented in this report primarily by the captioned photographs showing these typical American families evacuating their homes, driving to rural shelter-building sites, and then, with hand tools, constructing their own shelters. These average, mostly urban, American families were guided only by step-by-step, well-illustrated, written instructions given to them at the start of each experiment. Crisis conditions were simulated, and adequate motivation was provided by the promise of a cash bonus for completion of the shelter within 36 or 48 hours, depending on the difficulty of construction. All families, or groups of families, succeded in winning the bonus, with one exception. The shelters built by the test families included the Door-Covered Trench Shelter, the Log-Covered Trench Shelter (which the building family occupied for 77 hours without emerging), and the Car-Over-Trench Shelter. Also, families are pictured while building four above-ground shelters designed for high-water-table or shallow-soil areas: the Above-Ground-Covered Shelter, the Crib-Walled Shelter, the Ridge-Pole Shelter, and the A-Frame Pole Shelter. These four above-ground shelters have protection factors (PF) in the range of 250 to 500. The building in Alabama of a 50-occupant Log-Covered Trench Shelter, with 22-ft logs roofing a bulldozed trench, is illustrated and described, and the delays and inefficiencies of mechanized shelter-building during a rainy spell are noted. (auth)

Information Handling

Refer also to abstract 23393.

25331 (COO-2547-3) PLANNING FOR A PROGRAM DESIGN FOR ENERGY ENVIRONMENTAL ANALYSIS. Progress Report, April 1, 1975–June 30, 1975. Denton, J. C. (Pennsylvania Univ., Philadelphia (USA)). 1975. Contract AT(11-1)-2547. 11p. Dep. NTIS $3.50.

The work reported in this second quarterly progress report has focussed on completing the first generation approach to the use of operational gaming in a regional assessment study program, writing an interim report on the work accomplished, and progress on the second generation approach which attempts to quantify the mechanisms identified in the first generation approach. The interim report, provided as an addendum to this report, provides detailed descriptions of the first generation work. This report provides a brief summary of the initial work on the second generation approach as well as the first generation approach. (auth)

Law

25332 LAWS AND REGULATIONS GOVERNING NUCLEAR EXPORTS AND DOMESTIC AND INTERNATIONAL NUCLEAR SAFEGUARDS. Message From the President of the United States, Ninety-Fourth Congress, First Session, May 6, 1975. House Document No. 94-131. Washington, DC; Committee on Atomic Energy (1975). 55p. GPO.

The effectiveness of U.S. laws and regulations governing nuclear exports in preventing the diversion of nuclear capabilities to non-peaceful purposes is considered. It is concluded that current laws provide ample authority to control the export and re-export of nuclear-related material, equipment and technology. Constant vigilance is urged. (PCS)

Management

Refer also to abstract 23469.

25333 (AECL-5021) JOIN THE NUCLEAR TEAM. (Atomic Energy of Canada Ltd., Ottawa, Ontario). Nov 1974. 35p. (In French and English). Dep. NTIS (US Sales Only) $4.00.

Employment opportunities at the AECL are presented. The topics discussed include the foreward, AECL as a company, Chalk River Nuclear Laboratories, commercial products, heavy water projects, power projects, Whiteshell Nuclear Research Establishment, head office, and company benefits. The report is presented in both English and French. (TFD)

25334 (COO-2547-1) PLANNING FOR A PROGRAM DESIGN FOR ENERGY ENVIRONMENTAL ANALYSIS. Progress Report. Denton, J. C. (Pennsylvania Univ., Philadelphia (USA). National Center for Energy Management and Power). [nd]. Contract AT(11-1)-2547. 6p. Dep. NTIS $3.50.

The work reported in this progress report is focused on determining the proper scope of a regional assessment study program suitable for BER/ERDA. Within the tentative scope selected, a tentative set of purposes, goals, and objectives is identified for a preliminary specification of a geographical region. The initial specification of the region includes the states of Pennsylvania, New Jersey, Delaware, Maryland, and Virginia. The tentative scope of considerations for the regional assessment study program encompasses the interacting facets of environment, energy, and economic well-being of the region with the overarching goal of reconciling these facets within the decision framework of the region. (auth)

25335 (NIRS-14) ANNUAL REPORT, 1974. (National Inst. of Radiological Sciences, Chiba (Japan)). Sep 1975. 91p. Dep. NTIS (US Sales Only) $5.00.

Separate abstracts were prepared for each of the four sections in this report. (RWR)

For abstracts of individual sections see: 23456, 23517, 23560, and 24995.

25336 (NP-20776) ANALYSIS OF THE ERDA PLAN AND PROGRAM. (Office of Technology Assessment (U. S. Congress), Washington, D. C.). Oct 1975. 327p. GPO $3.85.

An analysis is presented of the program plan submitted by the Energy Research and Development Administration to Congress on June 30, 1975, entitled "A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future." The assessment was made by the Office of Technology Assessment (OTA) to provide Congress with background information necessary for an effective analysis of the ERDA Plan and Program in the major areas of: fossil energy; nuclear energy; solar, geothermal, and advanced technologies; conservation; and environment and health. Volume I of the ERDA Plan is stated to be a "significant milestone in the evolution of a long-term national energy policy," but that "the ERDA Program (Volume II), to implement this plan, does not appear adequate to achieve the stated goals." Two major deficiencies are stated. The first deficiency "occurs because of ERDA's pursuit of technological options at the expense of a focus on a broader approach toward the solution of energy problems" and "the second departure from congressional mandate is to be found in the emphasis of both the ERDA Plan and

Program on options directed toward increased energy supply, relative to the programs in end use demand reduction." (MCW)

25337 (PEL-247) LIST OF UNCLASSIFIED PEL REPORTS, 1 MARCH 1957–31 MARCH 1975. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Aug 1975. 12p. (In Afrikaans and English). Dep. NTIS (US Sales Only) $3.50.

Author and report number indexes are contained in this listing of unclassified PEL reports for the period March 1, 1957 to March 31, 1975. (RWR)

Mathematics and Computers

Refer also to abstracts 23335, 24649, and 24652.

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